The theme of the Advance Planning Briefing for Industry is "The Army Research Laboratory - Providing Technology to the Soldier." The objectives of the Advance Planning Briefing for Industry are to: a. Introduce the U.S. Army Research Laboratory (ARL); b. Present technologies in which ARL has an interest and is planning to pursue for the mid-and long term; c. Show planning budgets for these new technologies; e. Give the private sector and the academic community a preview in order to make sure that industrial and academic research and development investments coincide with the needs of the U.S. Army; f. Give the private sector and the academic community an opportunity to meet with the directorate executives, engineers and scientists who are responsible for the ARL business areas and are working on the new technologies.

This briefing was designated for industry executives and academic research manager involved in advance planning along with scientific and engineering management responsible for cooperative and independent R&D efforts.
DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.
# General Instructions for Completing SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to stay within the lines to meet optical scanning requirements.

### Block 1. Agency Use Only (Leave blank).

### Block 2. Report Date. Full publication date including day, month, and year. If available (e.g. 1 Jan 88) must cite at least the year.

### Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

### Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

### Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Contract</td>
</tr>
<tr>
<td>G</td>
<td>Grant</td>
</tr>
<tr>
<td>PE</td>
<td>Program</td>
</tr>
<tr>
<td>PR</td>
<td>Project</td>
</tr>
<tr>
<td>TA</td>
<td>Task</td>
</tr>
<tr>
<td>WU</td>
<td>Work Unit</td>
</tr>
<tr>
<td>Accession No.</td>
<td>Element</td>
</tr>
</tbody>
</table>

### Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

### Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

### Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

### Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

### Block 10. Sponsoring/Monitoring Agency Report Number. (If known)

### Block 11. Supplementary Notes. Enter information not included elsewhere such as:

- Prepared in cooperation with...; Trans. of...; To be published in...
- When a report is revised, include a statement whether the new report supersedes or supplements the older report.

### Block 12a. Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

<table>
<thead>
<tr>
<th>Agency</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOD</td>
<td>See DoDD 5230.24, &quot;Distribution Statements on Technical Documents.&quot;</td>
</tr>
<tr>
<td>DOE</td>
<td>See authorities.</td>
</tr>
<tr>
<td>NASA</td>
<td>See Handbook NHB 2200.2.</td>
</tr>
<tr>
<td>NTIS</td>
<td>Leave blank.</td>
</tr>
</tbody>
</table>

### Block 12b. Distribution Code.

<table>
<thead>
<tr>
<th>Agency</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOD</td>
<td>- DOD - Leave blank.</td>
</tr>
<tr>
<td>DOE</td>
<td>- DOE - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.</td>
</tr>
<tr>
<td>NTIS</td>
<td>- NTIS - Leave blank.</td>
</tr>
</tbody>
</table>

### Block 13. Abstract. Include a brief (Maximum 200 words) factual summary of the most significant information contained in the report.

### Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

### Block 15. Number of Pages. Enter the total number of pages.

### Block 16. Price Code. Enter appropriate price code (NTIS only).


### Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.
The Army Research Laboratory presents

Proceedings of the Advance Planning Briefing for Industry

Providing Technology to the Soldier

at the
US Naval Surface Warfare Center
White Oak, Md
27–28 January 1993

Approved for Public Release: Distribution is Unlimited
27 JANUARY 1993

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:00-6:00</td>
<td>Early Registration</td>
<td>Maryland Inn-Laurel</td>
</tr>
<tr>
<td>6:00-8:00</td>
<td>Reception</td>
<td>Maryland Inn-Laurel</td>
</tr>
</tbody>
</table>

28 JANUARY 1993

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00-9:00</td>
<td>Registration</td>
<td>Naval Surface Warfare Center, White Oak, Maryland</td>
</tr>
<tr>
<td>7:50</td>
<td>Administrative Remarks</td>
<td></td>
</tr>
<tr>
<td>8:00-8:05</td>
<td>Welcome</td>
<td></td>
</tr>
<tr>
<td>8:05-8:25</td>
<td>Keynote, Reshaping Our Business</td>
<td></td>
</tr>
<tr>
<td>8:25-8:45</td>
<td>Battle Labs - The User's Perspective on Technology</td>
<td></td>
</tr>
<tr>
<td>8:45-9:15</td>
<td>ARL Overview</td>
<td></td>
</tr>
<tr>
<td>9:15-9:45</td>
<td>Interfacing with ARL</td>
<td></td>
</tr>
<tr>
<td>9:45-10:00</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>10:00-10:30</td>
<td>Weapons Technology</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>Topic</td>
<td>Presenter</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td>10:30-11:10</td>
<td>Sensors, Signatures, Signal and Information Processing and Battlefield Combat Identification</td>
<td>Mr. Richard D. Slife Assistant Director for Programs, Sensors, Signatures, Signal and Information Processing</td>
</tr>
<tr>
<td>11:10-11:40</td>
<td>Materials</td>
<td>Mr. Lawrence D. Johnson Directorate Executive, Materials</td>
</tr>
<tr>
<td>11:40-12:10</td>
<td>Vehicle Propulsion</td>
<td>Mr. George A. Dobula, Directorate Executive (acting), Vehicle Propulsion</td>
</tr>
<tr>
<td>12:10-12:40</td>
<td>Battlefield Environment</td>
<td>COL Ronald Evans, Directorate Executive, Battlefield Environment</td>
</tr>
<tr>
<td>12:40-1:45</td>
<td>Lunch</td>
<td></td>
</tr>
<tr>
<td>1:45-2:15</td>
<td>Electronics and Power Sources</td>
<td>Dr. Clare Thornton, Directorate Executive, Electronics and Power Sources</td>
</tr>
<tr>
<td>2:15-2:45</td>
<td>Human Research and Engineering</td>
<td>Dr. Robin L. Keesee, Directorate Executive, Human Research and Engineering</td>
</tr>
<tr>
<td>2:45-3:15</td>
<td>Vehicle Structures</td>
<td>Dr. Wolf Elber, Directorate Executive, Vehicle Structures</td>
</tr>
<tr>
<td>3:15-3:30</td>
<td>Break</td>
<td></td>
</tr>
<tr>
<td>3:30-4:00</td>
<td>Advanced Computational and Informational Science</td>
<td>Dr. Andrew Mark Chief (acting), Simulation Technology Division, Advanced Computational and Informational Science Directorate</td>
</tr>
<tr>
<td>4:00-4:30</td>
<td>Survivability/Lethality Analysis</td>
<td>Dr. Jack Wade, Directorate Executive (acting), Survivability/Lethality Analysis</td>
</tr>
<tr>
<td>4:30-4:45</td>
<td>Wrap up</td>
<td>COL Miller</td>
</tr>
</tbody>
</table>
KEYNOTE ADDRESS

Reshaping Our Business

LTG Leo J. Pigaty
Deputy Commander
U.S. Army Materiel Command
Reshaping Our Business

LTG LEO J. PIGATY
28 Jan 93

AMC – Equip and Sustain the Force

Supply
Weapon Systems
Spares
Distribution
Maintenance
Transportation

Contracting
Foreign Sales
Acquisition
Industrial Base

Research
Development
Testing
Production

One Stop Shop

Responsive Logistics Support

Smart Buying

Superior Technology
AMC – Our Army Customer is Changing

Then...
- Bipolar
- Unified Threat
- Containment
- Europe-Soviet
- Forward Based
- Structured
- Mobilization
- Nuclear
- Attrition

Now...
- Multipolar
- Vague Threat
- Crisis Response
- Regional
- Conus Based
- Tailored
- Force Generation
- Conventional
- Precision

Not A Smaller Cold War Army
But Smaller (5&28 → 4&20)

AMC – A Business in Transition

<table>
<thead>
<tr>
<th>Year</th>
<th>Army Military</th>
<th>Army Civilian</th>
<th>AMC Civilian</th>
<th>AMC Military</th>
</tr>
</thead>
<tbody>
<tr>
<td>1989</td>
<td>735,000</td>
<td>403,000</td>
<td>102,600</td>
<td>8,900</td>
</tr>
<tr>
<td>1992</td>
<td></td>
<td></td>
<td>87,500</td>
<td>7,400</td>
</tr>
<tr>
<td>1995</td>
<td></td>
<td></td>
<td>77,400</td>
<td>5,600</td>
</tr>
</tbody>
</table>

Need to Reshape -- SMART!
Core Competencies

**Definition**

- Makes significant contribution to Army
- Value difficult to imitate or duplicate
- Absence of which presents unacceptable risk
AMC: Business Themes for the 90's

Strategic Leadership (Penn State)

Strategic Management (MIT)

Excellence

Quality

Vision

Intent

Challenges

Reshape

Cultural Shift

Business Orientation

Value Added

Core Competencies

Outsource The Margins

Divest

Logistics Power Projection

- Sustainment
- Readiness
- Deployment
Acquisition Excellence

- Best Value
- Army-Industry Team
- Quality

Technology Generation & Application

- Requirements based
- Technology insertion
- World Class
Technology Generation & Application

Vision: A technologically superior Army equipped and sustained with innovative advanced technologies for rapid power projection and the achievement of decisive victory.

Strategies:
- Technology Generation
  - balanced
  - focused
  - smart buyer
  - leveraging
  - partnering
- Technology Application
  - reduce cycle time
  - ATD
- User Interaction
  - Simulation
  - integrated environments
  - interning
  - Quality
- C & G Cost Reduction
- Work Force & Infrastructure

- Continuous Modernization
- Faster Application
- Seamless (Army - Industry - User - Academia)
  - High Payoff
  - World Class

AMC - Planning for Tomorrow's Business

Core Competencies
Missions
Business Plan
Business Processes

Reshape 95 - 96
- customers
- revenue
- costs
- work force
available

Must look to the future to ensure our actions today will get us to the right place.
AMC - Continuing The March

- SUSTAIN
- SUPPORT
- GO TO WAR

THE TOTAL ARMY
Battle Labs
The User's Perspective on Technology

COL William D. Hubbard
Director, Battle Lab
Integration and Technology Directorate,
U.S. Army Training and Doctrine Command
(804) 728-5850
BATTLE LABS

AN OVERVIEW

MAINTAINING THE EDGE

CONTEXT FOR CHANGE

STRATEGY/DOCTRINE

- FORCE PROJECTION STRATEGY
- GLOBAL RESPONSIBILITY
- AMBIGUOUS SCENARIOS
- LOW - TO - HIGH TECH THREAT
- DYNAMICS OF BATTLE IN TRANSITION
- MIXED ACRC FORCE

RESOURCES

- REDUCED DEFENSE RESOURCES
- MOST DOD SAT DOLLARS ARE NOT 'SERVICES'
- DEFENSE RAD DOWN 30% BY 1997
- MAJOR INVESTMENT IN EXTANT FLEET
- NEED TO REDUCE O&S COSTS

SOLDIERS-LEADERS

AN ELITE FORCE OF TRAINED & READY SOLDIERS AND LEADERS WITH UNLIMITED CAPACITY TO RAPIDLY MASTER CHANGES IN:

- DOCTRINE
- EQUIPMENT
- TACTICS

MODERNIZATION

- TECHNOLOGICAL OPPORTUNITIES
- NEED TO MODERNIZE
- FEWER NEW STARTS
- CURRENT PROCESS ALLOWS FLEXIBILITY...BUT UNTESTED

TRADOC WHERE TOMORROW'S VICTORIES BEGIN
### TRADOC Analysis of the Future Battlefield

<table>
<thead>
<tr>
<th>Factor</th>
<th>Impact</th>
<th>Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force Projection</td>
<td>Early vulnerability</td>
<td>Greater early entry lethality &amp; survivability</td>
</tr>
<tr>
<td>High lethality indirect</td>
<td>Battles finish faster - higher tempo</td>
<td>Evolving notion of Depth &amp; Simultaneous Attracks</td>
</tr>
<tr>
<td>Extended range indirect</td>
<td>Class III drives LOG - not Class IV</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Close at extended range</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reduced casualties</td>
<td></td>
</tr>
<tr>
<td>Improved Intelligence</td>
<td>Deal a knockout blow</td>
<td>Evolving notion of Depth &amp; Simultaneous Attracks</td>
</tr>
<tr>
<td></td>
<td>Increased vulnerability at depth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Importance of RSTA/Jtcounter RSTA</td>
<td></td>
</tr>
<tr>
<td>Improved C2</td>
<td>Take the initiative - break the enemy</td>
<td>Expanding battle space - Continuing the historic trend</td>
</tr>
<tr>
<td></td>
<td>Reduced reaction time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Improve synchronization</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Temptation to centralize</td>
<td></td>
</tr>
<tr>
<td>Lower Force Density</td>
<td>Increased opportunity to avoid close battles: Interpenetration, flanking</td>
<td>Controlling the Tempo of the fight - C2 on the move</td>
</tr>
<tr>
<td></td>
<td>Greater scope for initiative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greater reliance on quality soldiers</td>
<td></td>
</tr>
<tr>
<td>Weapons of Mass Destruction</td>
<td>Possibility of catastrophic losses from single engagement</td>
<td>Sustaining the fight - CSS</td>
</tr>
<tr>
<td></td>
<td>Limits ability to concentrate forces</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pressure for geographic expansion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Greater threat from mobile TBMES</td>
<td></td>
</tr>
<tr>
<td>CNN / broadcast news</td>
<td>Link political and tactical echelons</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Become a point of leverage by both sides</td>
<td></td>
</tr>
</tbody>
</table>

**Our Challenge**

- Importance of Technology to Cold War and Desert Storm Victories
- Army Budget Trends
- High Tech Transfer
- Unstable Regional Powers

**MUST MAINTAIN THE EDGE**
THE ARMY'S RESPONSE

- AN APPROACH THAT FITS OUR ARMY -

BATTLE LABS - A means to develop capabilities for a Force Projection Army that begins where BATTLE APPEARS TO BE CHANGING and that encourages experimentation via simulations or prototypes to determine technology insertion or new requirements.

SUCCESSFUL PRECEDENTS

- HOWZE BOARD
- 11TH AIR ASSAULT
- TRICAP
- 9TH DIV TEST BED
- 2 AD NIGHT EXPERIMENTS

TRADOC WHERE TOMORROW'S VICTORIES BEGIN

PROCESS
- Conceptualize
- Analyze
- Simulate
- Experiment
- Evaluate
- Prioritize

SOLUTIONS
Expressed in terms of:
- Doctrine
- Training
- Leadership
- Organizations
- Materiel
- Soldiers

BENEFITS
- Brings together users, S&T, and other players
- Louisiana Maneuvers Interface
AMC SUPPORT TO BATTLE LABS

BATTLE LAB
- EARLY ENTRY
- MOUNTED
- DISMOUNTED
- DEEP & SIM ATTACK
- BATTLE COMMAND
- CSS

LEAD RDEC
- MISSILE
- TANK & AUTOMOTIVE
- Natick
- ARMAMENTS
- COMMUNICATIONS & ELECTRONICS
- BELVOIR

SUPPORTING ALL BATTLE LABS
- ARMY RESEARCH LABORATORIES (ARL)
- ARMY RESEARCH OFFICE (ARO)
- AVIATION RDEC
- EDGEWOOD RDEC
- STRICOM

BATTLE LAB COMMUNICATIONS NETWORKING

- Electronic interconnection is key
  - Remote access to joint models and simulations
  - Virtual prototyping with industry and academia
  - Support to Louisiana Maneuvers
- DSI is critical link

TRADEC: WHERE TOMORROW'S VICTORIES BEGIN
ARMY MODERNIZATION VISION
BATTLE LAB LINKS

**BATTLE LABS**
- Early Entry, Lethality, and Survivability
- Battle Space
- CSS
- Depth & Simo Atk
- Battle Command

**MODERNIZATION OBJ**
- Protect the Force
- Dominate Maneuver: Battle
- Protect & Sustain
- Conduct Precision-Strikes
- Win the Info War

INTEGRATION - KEY
AS A FORCE WE FIGHT AS
AN INTEGRATED COMBINED ARMS TEAM

- Within the Fighting Force and Each B.O.S.
- Tailor, Reorganize, Resupply, Realign Between Echelons
- Nested Intents within a Unified Concept

BATTLE LABS MUST BE INTEGRATED...FROM A VERTICAL AND HORIZONTAL INTEGRATION PERSPECTIVE

HORIZONTALLY
- Within a WFX Team
- From CO to Corps
- Across All B.O.S.
- Maneuver
- Intel
- Fires
- Aviation
- Air Defense
- CSS
- Engineers

TRAJOS: WHERE TOMORROW'S VICTORIES BEGIN
**BATTLE LABORATORY**

**PROVIDE OPPORTUNITIES FOR**

- INTEGRATED REQUIREMENTS AND DEVELOPMENTS
  - INTEGRATE MULTIPLE BATTLEFIELD OPERATING SYSTEMS
  - SIMULATION
  - PROTOTYPING
  - EXPERIMENTATION & TESTING
  - EVALUATION

- MATERIEL DEVELOPER PARTICIPATES IN REQUIREMENTS DEFINITION
  - INDUSTRY
  - ACADEMIA

- FREEDOM TO EXPLORE
  - CREATIVITY & INNOVATION
  - LEVERAGE TECHNOLOGICAL OPPORTUNITIES
  - AVOID SUCCOTRATON AND ATROPHY BY BUREAUCRATS

**PRODUCES**

- SMART & AFFORDABLE ALTERNATIVES

- RISK REDUCTION OPPORTUNITIES FOR
  - RDA PROCESS

**BATTLE LABS**

WARFIGHTING
- HQ Above Corps
- Mil Ops w/unfamiliar Forces
- Own the Night
- Battle Command
- C4I - FPA(C2) - Intel

MANEUVERS
- BOD
- Issues
- Report
- Recommended Solutions

BATTLE LABS
- GOWG
- Refine & Scope
- Issues and Tools
- DA

DEPARTMENTAL
- CONUSA
- Equipping
- Mobilization
- Sustainment
- Deployment

FIELD, AMC

TRADOC: WHERE TOMORROW'S VICTORIES BEGIN
Risk Reduction During High Spending Phases is Expensive

**AVENGER**

*An Example of Historical Experimentation*

- Existing chassis - HMMWV
- Existing weapon system - Stinger
- Integrated - Mount and Advanced FLIR
- Expedited Acquisition Process
  - Contractor built prototype for 9ID / ADEA using off-the-shelf components in Army inventory... documentation, spares and manufacturing costs significantly reduced
  - Tested in field by soldiers (9ID / ADEA)
  - Milestone IIIA to fielding in 36 months (no milestone 0 thru III)
Battle Labs

Battle Command
Fort Leavenworth, Kansas

Mounted Battlespace
Fort Knox, Kentucky

Combat Service Support
Fort Lee, Virginia

Early Entry Lethality & Survivability
Fort Monroe, VA

Depth & Simultaneous Attack
Fort Sill, Oklahoma

Dismounted Battlespace
Fort Benning, Georgia

EARLY ENTRY LETHALITY & SURVIVABILITY

Areas of Focus
- Optimizes lethality of Early Entry Forces
- Lightens armored forces
  (deploy in 1/2 time with less lift)
- Offsets IPB capability
- Optimizes force mix configurations
- Capitalizes on SOF & other Services to enhance lethality and survivability

Versatile / Joint
Fight during / after deployment
Areas of Focus
- Optimize situational awareness and target handoff
- Optimize survivability of mounted force
- Expand multiple capabilities to acquire/kill armored targets, day/night, at long range
- Optimize horizontal integration of digitized information flow (Slide 9)
- Determine optimum force design of recon & sec elements, Bde thru Corp

MOUNTED BATTLE SPACE
THE TALE OF THE TAPE

- Greater lethal reach
- Concentrate effects, w/o concentrating forces

"I only knew the Americans were out there when the tank to the left of me, then the tank to the right of me exploded."
An Iraqi Commander

Areas of Focus
- Optimize night fighting capability of combined arms force
- Improve target acquisition capabilities for combined arms force
- Enhance lethality of dismounted force
- Improve survivability of soldiers

DISMOUNTED BATTLE SPACE
THE TALE OF THE TAPE

- Greater lethality
- Improved survivability
**DEPTH AND SIMULTANEOUS ATTACK**

- Simultaneous 3-D Attack throughout battlefield
- Deny sanctuary

Areas of Focus

- Leverage technology to increase accuracy / 1st round kills
- Detect enemy at max depth
- Provide near real time intel info
- Link IEW and attack systems to optimize precision targeting

**BATTLE COMMAND**

- Space Based C3I
- Leadership / Human Dimension
- Digitization

Areas of Focus

- Develop robust C2 OTM ... begin with C2V
- Optimize space-based systems for OPS, intelligence and training
- Improve/streamline interoperability with joint/combined networks
- Optimize broadcast technology
- Optimize CSS battlefield automation
Areas of Focus
- Develop effective total distribution management system with total asset visibility
- Optimize soldier and systems sustainment
- Improve logistics commo and automation
- Optimize logistics force design to best support Force Projection Army

Potential Joint Interface
- Battle Command
  Fort Leavenworth, KS
  - Joint C4I
  - Enhancement of Space-based Systems (Ops, Intell, Tng)
  - Communications Payloads for UAVs
  - Enroute Communications

- Combat Service Support
  Fort Lee, VA
  - Joint Logistics Over the Net (JLOTS)
  - Total Asset Visibility
  - Split Base Operations

- Early Entry Lethality & Survivability
  Fort Monroe, VA
  - LR
  - Offset Intelligence
  - Forcible Entry

- Depth & Simultaneous Attack
  Fort Sill, OK
  - Integrate Deep Attack Systems
  - Patriot-AEGIS Interface
  - Reducing Sensor to Shooter Timeline

- Mounted Battlespace
  Fort Knox, KY
  - Digitization
  - Long-range Gunnery
  - Bodyguard (Electronic Protection of Systems)

- Dismounted Battlespace
  Fort Benning, GA
  - Night Fighting Enhancements
  - Soldier Integrated Protective Ensemble (SIPE)
  - Biological Agent Detection
EXAMPLES OF BATTLE LAB INITIATIVES

- Early Entry
- Mounted Battle Space
  - Digitization
  - Position
  - Navigation
  - Bodyguard
- Battle Command
  - C2 Vehicle
  - Post Cold War Cmd & Control
  - Battle Cmd Study
  - Tactical-Strategic Interoperability

BATTLE LABS

Battle Command
COL John C. Eberle
DSN: 653-3329
CMH: (913) 546-3329
FAX: (913) 546-4408
Mailing Address:
COMUSACOM JWR
ATTN: ATL C2S
P. O. Box 21620
Crawfordville, FL 32321-6828

COE
COL Michael S. Williams
DSN: 667-1450
CMH: (910) 754-1450
FAX: (910) 754-2890
Mailing Address:
COMUSACOM JWR
ATTN: ATL C2S
P. O. Box 21620
Crawfordville, FL 32321-6828

Depth & Simultaneous Attack
COL Donald Kerr
DSN: 334-8047
CMH: (605) 351-4647
FAX: (605) 351-4628
Mailing Address:
COMUSAF-JWR
ATTN: ATLAS-C2S
皮奥里亚, IL 61612-4009

Mounted Battle space
COL David L. Porter
DSN: 484-3237
CMH: (503) 554-3237
FAX: (503) 554-3237
Mailing Address:
COMUSAF-JWR
ATTN: ATLAS-C2S
皮奥里亚, IL 61612-4009

Dismounted Battle space
COL Arnold J. Canade
DSN: 521-3350
CMH: (703) 354-2310
FAX: (703) 354-2317
Mailing Address:
COMUSAF-JWR
ATTN: ATLAS-C2S
皮奥里亚, IL 61612-4009

Early Entry Lethality
and Survivability
LTC Ronald L. Stewart
DSN: 488-7690
CMH: (910) 754-3270
FAX: (910) 754-2890
Mailing Address:
COMUSACOM JWR
ATTN: ATLAS-C2S
P. O. Box 21620
Crawfordville, FL 32321-6828
SUMMARY

Battle Labs are a pragmatic approach to problem-solving that allows experimentation — first in simulation and later with soldiers on ranges and maneuver areas — with new ideas and emerging technologies.

GEN FRANKS
TRADOC: Seeding Future Victories,
The Army Green Book, Oct 92
Overview of the United States Army Research Laboratory

Mr. Bruce M. Fonoroff
Directorate Executive
Advanced Concepts and Plans (ACAP)
(301) 394-4106
Our Challenge

- Less Predictable, Rising Threat
- Public Demands Swift, Decisive, Low Casualty Victory
- Less $

But a smaller Army and defense industry

Strategic Vision

U.S. Army
A Total Force trained and ready to fight...
Serving the nation at home and abroad...
A strategic force capable of decisive victory.

Army Materiel Command
The Army's leader in equipping and sustaining the Total Force through superior technology and responsive support assuring worldwide power projection and decisive victory.

Army Research Laboratory
An efficient, world-class laboratory with the critical mass and flexibility to satisfy the science, technology, and analysis needs of the Army for the 1990s and beyond.
Army S&T Organization

AMC Organization
Mission
The United States Army Research Laboratory will provide America's soldiers the technology edge through scientific research, technology development, and analysis.

Army–Wide Management Responsibilities
Technology Transfer

• Independent Research & Development (IR&D)
• Domestic Technology Transfer
  – Cooperative R&D Agreements (CRDAs)
  – Patent Licensing Agreements (PLAs)
• Small Business Innovation Research (SBIR)
• Advanced Concepts and Technology (ACT)

Advanced Field Artillery System Cannon (AFAS–C)
Corporate Laboratory Role

Army Research Laboratory
Research, technology and analysis for Army needs

Army Tech Base Elements
CECOM—CNVEO Optical/IR Research
ARI—MANPRINT for Systems Research
AVSCOM—Aviation Aerostructures Directorate
AVSCOM—Aviation Propulsion Directorate
TACOM—Ground Vehicle Propulsion Research
BRDEC—Tech Base Materials Research
AIRMICS
CRDEC—Chemical & Biological Vulnerability/Lethality Assessment

LABCOM
Atmospheric Sciences Laboratory
Ballistic Research Laboratory
Electronics Technology & Devices Laboratory
Harry Diamond Laboratories
Human Engineering Laboratory
Materials Technology Laboratory
Vulnerability Assessment Laboratory
Special Technology Offices

Divestitures
ARO and others

Transition to Army Research Laboratory

Strong in-house capability
Primarily 6.1, 6.2, 6.5
Institutional funding
Limited customer and contract programs
Board of directors oversees
Minimal overhead
ARL Organization

- Director
  - Military Deputy
  - Advanced Concepts & Plans
  - Operations

- Sensors, Signatures, Signal and Information Processing
- Electronics & Power Sources
- Battlefield Environment
- Survivability/Lethality Analysis
- Human Research & Engineering
- Vehicle Structures
- Advanced Computational & Information Sciences
- Weapons Technology
- Vehicle Propulsion
- Materials

ARL Locations

- Aberdeen Proving Ground, MD
  - Weapons Technology
  - Human Research & Engineering
  - Materials
  - Advanced Computational & Information Sciences
  - Survivability/Lethality Analysis

- NASA Lewis Research Center, OH
  - Vehicle Propulsion

- NASA Langley Research Center, VA
  - Vehicle Structures

- Adelphi Laboratory Center, MD
  - ARL Director
  - Electronics & Power Sources
  - Sensors, Signatures, Signal & Information Processing
  - Battlefield Environment

- White Sands Missile Range, NM
  - Survivability Analysis, Large Scale Outdoor Research & Experimentation

Transition sites: EPS at Ft. Monmouth, NJ and MAT at Watertown, MA
ARL Personnel Profile
As of Sept. 1992

<table>
<thead>
<tr>
<th>Scientists &amp; Engineers</th>
<th>1744</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical/Electronics Engineers</td>
<td>527</td>
</tr>
<tr>
<td>Physicists</td>
<td>228</td>
</tr>
<tr>
<td>Mechanical Engineers</td>
<td>179</td>
</tr>
<tr>
<td>Material Engineers/Metallurgists</td>
<td>112</td>
</tr>
<tr>
<td>General/Industrial Engineers</td>
<td>120</td>
</tr>
<tr>
<td>Human Factors Engineers</td>
<td>37</td>
</tr>
<tr>
<td>Aerospace Engineers</td>
<td>34</td>
</tr>
<tr>
<td>Chemical Engineers/Chemists</td>
<td>97</td>
</tr>
<tr>
<td>Mathematicians/Statisticians</td>
<td>92</td>
</tr>
<tr>
<td>Computer Scientists</td>
<td>50</td>
</tr>
<tr>
<td>Meteorologists</td>
<td>34</td>
</tr>
<tr>
<td>Physical Scientists</td>
<td>126</td>
</tr>
<tr>
<td>Operations Research Analysts</td>
<td>57</td>
</tr>
<tr>
<td>Other</td>
<td>51</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Workforce</th>
<th>3653</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelors</td>
<td>1207</td>
</tr>
<tr>
<td>Masters</td>
<td>528</td>
</tr>
<tr>
<td>Doctorates</td>
<td>354</td>
</tr>
</tbody>
</table>

ARL Resources
FY93 FUNDING ($483M)

6.1 $33.8
6.2 $140.9
6.3A $32.8
6.3B $7.9
6.5 $102.3
6.7 OMA $11.1

Source: Paul Johnson
8 Dec 92
ARL FY 93 Funds By Business Area
Total $509.5M

Materials $35.8
Human Research & Engineering $32.1
Electronics & Power Sources $51.9
Battlefield Environment $29.2
Advanced Computational & Information Science $6.7
Operations $42.5
Advanced Concepts & Plans $8.6

Survivability/Lethality Analysis $73.5

Target Acquisition
Advanced Armored Vehicle Technology
Autonomous Systems Science and Technology
Advanced Artillery Technology
Warrior's Edge

Definition
A multidisciplinary team approach for developing and evaluating key technical capabilities and concepts.

Attributes
• Major visibility
• Clear objective - product/capability
• Finite time frame
• Single directorate executive has lead
**Advanced Procurement Plan**

**SUMMARY**

- **Total ARL Procurements**: $296
- **Planned Incremental Funding**: $118
- **Planned New BAA Funding**: $31.8
- **Planned New SBIR Phase II Funding**: $6.5
- **Planned New SBIR Phase I Funding**: $2.6

*Estimated obligations in millions*

---

**WT Directorate**

**FY 93 Acquisition Plan**

*(Estimated obligations in millions)*

- **Two new, competitive actions estimated to exceed $1M each**
- **Plan includes 18 new BAA functions**
SLAD Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

ACTIONS | OBLIGATIONS
---------|------------------
121       | $140

Competitive contracts planned
computer simulation

Over half of actions are
incremental funding

S3I Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

ACTIONS | OBLIGATIONS
---------|------------------
194       | $250

Planning numerous
competitive actions under
$100K, extensive use of BAA
and SBIR
MAT Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

Planning significant SBIR, BAA usage

Most larger obligations are modifications to existing contracts
BE Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

Most other funded actions are modifications

HRE Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

No new contracts estimated to exceed $500K in plan

Numerous smaller Broad Agency Announcement actions planned
ACIS Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

Most obligations shown are modifications to existing contracts or currently unfunded actions.

Vehicle Propulsion Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

Most actions are grants to colleges and universities.
Vehicle Structures Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

Most actions are planned for colleges and universities.

ACAP Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

Omnibus Tech Base Contract, 4th Quarter Award
Most others are modifications
OPS Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

Most competitive actions are estimated under $100K, larger actions are modifications.

Technical Directors Office
FY 93 Acquisition Plan
(Estimated obligations in millions)

Most actions are modifications to existing contracts.
National Technology Policy

... My technology policy consists of six broad initiatives aimed at helping Americans develop and quickly utilize new technologies:

1. Investing in 21st century infrastructure
2. Establishing education and training programs for a high skill workforce;
3. Investing in technology programs that empower America's small businesses;
4. Refocusing Federal R&D programs on critical technologies that enhance industrial performance;
5. Leveraging the national R&D investment; and
6. Creating a world class business environment for private sector investment and innovation.

President Bill Clinton
Technology: The Engine of Economic Growth
September 21, 1992
Interfacing with ARL

Dr. Alan J. Goldman
Chief
Technology Transfer Division,
Advanced Concepts and Plans Directorate
(301) 394-2410
Purpose

• Mechanism for learning about ARL interests and potential contracts

• Formal programs involving contractor efforts

• Identify points of contact to get additional information

Agenda

• Technical and Industrial Liaison Programs

• Domestic Technology Transfer
  – CRDAs and PLAs

• Small Business Innovation Research

• Independent Research and Development

• Advanced Concepts and Technology
Technical & Industrial Liaison Office

• Advanced planning information
  – APBI
  – Broad Agency Announcement
  – Descriptive Information

• Match-making

• Unsolicited Proposal guidance

• Potential contractor program

• R&D unfunded studies

Current Broad Agency Announcement (BAA)

• Issued October 1992

• Open for 1 year or until superseded

• Ninety research topics described in detail

• Technical areas of interest delineated

• Minimum five percent of funds for institutions of higher learning set aside for HBCU/MI
Federal Technology Transfer Laws

The Stevenson Wydler Act (1980) and the Federal Technology Transfer Act (1986) (15 USC 3701 et seq) mandate active technology transfer from all Federal Laboratories to the Private Sector.

- Provides authority to enter Cooperative R&D Agreements and exclusively license intellectual property (15 USC 3710a)
- Charters the Federal Lab Consortium network to help locate technology
- Emphasizes cooperation/support for Small Businesses
- Provides minimum 15% of royalties to inventors and the majority of the balance to labs

Technology Transfer Mechanisms

**CRDA:** Cooperative Research and Development Agreements
- A pledge by a government laboratory and industry/academia to conduct joint R&D
- Government provides technical personnel, services, facilities, equipment and other resources, but no funds
- Industry/academia provide funds (if necessary), technical personnel, services, facilities, equipment and other resources
- Agreement defines sharing of intellectual property

**PLA:** Patent Licensing Agreements
- Provide financial incentive to inventors and labs
- Assure transition of technology to private sector
ARL Approved CRDAs/PLAs

Totals Per Each FY

<table>
<thead>
<tr>
<th>Agreements</th>
<th>FY88</th>
<th>FY89</th>
<th>FY90</th>
<th>FY91</th>
<th>FY92</th>
<th>FY93</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>11</td>
<td>14</td>
<td>25</td>
<td>45</td>
</tr>
</tbody>
</table>

FY 88-92 ARL Cumulative Totals = 58

Selected Examples

CRDA

- Crystal Oscillator Technology
- Patent Licensing
- Technology Trends:
  - Lower Power Consumption
  - Lighter and Smaller
  - More Stable (Better Compensated) Frequency Output
  - Immune to Vibrations
  - Immune to Radiation

- Martin Goffman Associates with Army Electronics and Power Sources Directorate
- E&PS Eximer Laser used by Goffman for R&D in Superconductors
- Applications:
  - High Temp Superconductor for Infrared Detection
  - Low Temp Superconductor for Electronic Devices

PLA

- Crystal Oscillator Technology
- Patent Licensing

- Technology Trends:
  - Lower Power Consumption
  - Lighter and Smaller
  - More Stable (Better Compensated) Frequency Output
  - Immune to Vibrations
  - Immune to Radiation

- Past
  - Power: 0.5 watt
  - Volume: 16 CU inches

- Future
  - Power: 0.02 watt
  - Volume: 2 CU inches
CRDA: Potential Research Areas

• Microelectronic Materials, Devices & Circuit Research
• Advanced Aerospace Materials Research & Analysis
• New Materials Stress-Strength-Inspection Technologies (For Both Air & Ground Vehicles)
• High Capacity Batteries & Energy Storage Technologies
• Sensor Fusion Technology

CRDA: Potential Research Areas

(Continued)

• Autonomous/Robotic Vehicle Research
• Vehicle Structure & Propulsion Systems Research
• Atmospheric Characterization at all Acoustic & Electromagnetic Wavelengths
• Solderability Techniques
• Survivability/Lethality Analysis
ARL Unique Facilities
Suitable for Potential CRDAs

- Microwave/Millimeter wave Design Center
- Nanoelectronics Fabrication Facility
- Cray 2 Facility
- Pulse Power Facility
- Fifty Wind Tunnel Configurations
  (Sub-, Trans-, Supersonic Flow Rates)
- Small/Medium/Large Caliber Research Facility
- Robotics and Automated Control Laboratory
- Adhesive Bonding Microfactory
- One of the largest (250') Crash Towers in Existence
- Molecular Beam Epitaxy Facility
- Triaxis Vibrator Facility
- High Power Microwave/Flash X-Ray/EMP Facilities
- Electro-Optical Vulnerability Assessment Facility (EOVAF)

Army SBIR Program History
Leverage Small Business Capabilities

Yearly Funding

Phase I
Technical Feasibility ($100K Max, 6 months)

Phase II
R&D Effort ($750K Max, 2 years)

Phase III
Transition (No SBIR $)
- Commercialize Products
- Other Government Funding
Fabrication of Fiber Reinforced Polymer Composite Curved Parts

**MILITARY USES**
- Howitzer Parts
- Rocket Launch Tubes
- Rocket Motor Cases
- Lightweight Bridging

**COMMERCIAL USES**
- Golf Shafts
- Surgical Tools
- Satellite Structures
- Aircraft Propellors

**FY93 Schedule**

- Issue Solicitation. ......................... 1 May
  (announced in Commerce Business Daily)
- Proposals Due ......................... 1 July
- Phase I winners selected .......... 1 September
- Phase II winners selected .... Approx. 9 months after Phase I award
Industry Independent Research & Development

- Company Funded, Reimbursed as Overhead
- Still Very Important
- Recent Improvements
  - Full Reimbursement
  - Reduced Reporting
  - More Frequent Guidance
- Concern—Dwindling Procurement $

An IR&D Success

Patriot
1960s—Basic Technology Established
- Ferrite Materials
- Ferrite Base Shifters
- Space Fed Phased Array

1970–1984—Basic ATM Capability Established
- Missile and Radar Sensitivity and Sub-Clutter Visibility Enhancements
- Warhead Redesign
- Corelation Subsystem Clutter Canceler
- Fuze Signal Processing
- Software Upgrades
- Warhead Redesign
- Microelectronics Insertion

Result

Desert Storm Success
**Advanced Concepts and Technology**

- Encourage Innovation
- Alternative Channel for Good Ideas
- Approximately 2 yrs./$1M max.
- Funded at $4-6 Million per year

---

**Computer-Aided Process Design**

*Steel Heat Treat Process Modeling*

*Replaces Empirical Approach*

- Reduce Development Time/Cost
- Improve Quality
- Reduce Reject/Rework

*Quenched Cracked Barrel*

**Initial Successful Effort**

- Large, Gun Barrels
- ACT, ARDEC Benet Lab & ADLittle
- Problem
  - Quench too quickly—cracks
  - Quench too slowly—soft steel
- Solution
  - Modelling for process optimization

*Helicopter Gear*

*Dimensional Measurements*

**Current Effort**

- Helicopter Gears
- ACT, AVSCOM, ADLittle, Sikorsky
- Commercial Applications
  - Automotive, Nat'l Center for Manufacturing Science
- Problem
  - Heat treat distortion
  - Causes reject/rework
- Solution
  - Process design by modelling
Challenge to Industry

- Maintain Awareness of Army Technology Needs
  - Requirements & planning documents
  - Interactions with Labs & Centers

- Focus IR&D on Army Needs / Opportunities
  - Respond to technical evaluations & on-site reviews

- Seek Cooperative Research and Development Agreements (CRDAs) and Patent Licensing Agreements (PLAs)

- Inform Army of Accomplishments
  - Brief Labs & Centers
  - Demonstrate new technologies
POINTS OF CONTACT
"INFORMATION FOR INDUSTRY PROGRAM"

PROCUREMENT

MR. ROBERT M. TOMKO (301) 394-3690

TECHNICAL AND INDUSTRIAL
LIAISON OFFICER (TILO)

MR. MELVYN J. SHICHTMAN (301) 394-5075

DOMESTIC TECHNOLOGY TRANSFER
COOPERATIVE R&D
AGREEMENTS (CRDAs)
PATENT LICENSE
AGREEMENTS (PLAs)

ARL - MR. MICHAEL CLAFFY (301) 394-4210
ARMY WIDE - MR. CLIFFORD LANHAM
(301) 394-4210

SMALL BUSINESS
INNOVATION RESEARCH (SBIR)

ARL - MR. M. DEAN HUDSON (301) 394-4808
ARMY WIDE - MR. J. PATRICK FORRY
(301) 394-4602

INDEPENDENT RESEARCH
AND DEVELOPMENT (IR&D)

ARL - MR. BRYAN D. JOHNSON (301) 394-2410
ARMY WIDE - DR. ALAN J. GOLDMAN
(301) 394-2410

INTERNATIONAL PROGRAMS

DR. DAVID C. HODGE (410) 278-5865
MR. FRED ADLER (301) 394-1400
DATE: 12/23/92

ARMY ACCEPTED CRDAs/PLAs (ARL)

TOTAL CRDAs: 48 TOTAL PLAs: 10 TOTAL CPAR CRDAs: 0

CONTROL NO: 9211-A-C234 TYPE: CRDA
LAB: ARL ORTA POC: Mike Claffy PHONE NO.: 301-394-4210
COMPANY: Adv Lithography Grp
PURPOSE: For development of ion projection lithography.

CONTROL NO: 9209-A-C222 TYPE: CRDA
LAB: HDL ORTA POC: Norma Vaught PHONE NO.: 301-394-2952
COMPANY: Delco Electronics
PURPOSE: For R&D of Sequential Electrochemical Reduction Analysis procedures and equipment in a production environment.

CONTROL NO: 9209-A-C221 TYPE: CRDA
LAB: HDL ORTA POC: Norma Vaught PHONE NO.: 301-394-2952
COMPANY: Texas Instruments
PURPOSE: For R&D of Sequential Electrochemical Reduction Analysis procedures and equipment in a production environment.

CONTROL NO: 9209-A-C220 TYPE: CRDA
LAB: HDL ORTA POC: Norma Vaught PHONE NO.: 301-394-2952
COMPANY: Johns Hopkins Univ
PURPOSE: For R&D on the monitoring and control of printed circuit board plating thickness.

CONTROL NO: 9209-A-C217 TYPE: CRDA
LAB: HDL ORTA POC: Norma Vaught PHONE NO.: 301-394-2952
COMPANY: Univ of MD
PURPOSE: To develop Mossbauer Spectroscopy into a process control tool for composite solders.

CONTROL NO: 9208-A-C209 TYPE: CRDA
LAB: MTL ORTA POC: Dr. Hamed El-Bisi PHONE NO.: 617-923-5396
COMPANY: Assembly Guidance
PURPOSE: For development of improved processing methods for fabricating parts from composite materials.

CONTROL NO: 9208-A-C207 TYPE: CRDA
LAB: HDL ORTA POC: Norma Vaught PHONE NO.: 301-394-2952
COMPANY: Washington Univ
PURPOSE: For development of composite solders.
CONTROL NO: 9207-A-C200  TYPE: CRDA  ACCEPTED: 08/10/92
LAB:  HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY:  Univ of MD
PURPOSE:  For development of computerized design models for solder behavior as a function of microstructure.

CONTROL NO: 9207-A-P199  TYPE: PLA  ACCEPTED: 08/05/92
LAB:  ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY:  Hewlett-Packard Co
PURPOSE:  For a partially exclusive license for U.S. Patent No. 4,410,902, entitled "Planar Doped Barrier Semiconductor Device".

LAB:  ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY:  Techtrol Cyclonetics
PURPOSE:  For R&D of ultra-stable low phase noise dielectric resonator oscillators.

CONTROL NO: 9206-A-C194  TYPE: CRDA  ACCEPTED: 07/24/92
LAB:  MTL  ORTA POC: Dr. Hamed El-Bisi  PHONE NO.: 617-923-5396
COMPANY:  Composite Dvlpmnt
PURPOSE:  For full scale fabrication and optimization of composite cylinder processing.

CONTROL NO: 9205-A-C184  TYPE: CRDA  ACCEPTED: 06/02/92
LAB:  HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY:  Raynet Corp
PURPOSE:  For R&D of a surface oxide evaluation system.

CONTROL NO: 9204-A-C176  TYPE: CRDA  ACCEPTED: 05/21/92
LAB:  HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY:  Harris Corp
PURPOSE:  To study the Sequential Electrochemical Reduction Analysis (SERA) technique for measuring solderability of electronic components.

CONTROL NO: 9204-A-C175  TYPE: CRDA  ACCEPTED: 05/21/92
LAB:  HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY:  Motorola, Inc
PURPOSE:  To study the Sequential Electrochemical Reduction Analysis (SERA) technique for measuring solderability of electronic components.

CONTROL NO: 9204-A-C173  TYPE: CRDA  ACCEPTED: 05/01/92
LAB:  ASTD  ORTA POC: John Cline  PHONE NO.: 804-864-3966
COMPANY:  McDonnell Douglas
PURPOSE:  For development of a design analysis methodology for a composite helicopter rotor hub.
CONTROL NO: 9203-A-C162  TYPE: CRDA  ACCEPTED: 04/17/92
LAB:  ASTD  ORTA POC: John Cline  PHONE NO.: 804-864-3966
COMPANY: McDonnell Douglas
PURPOSE: For wind tunnel testing of the British Program - Type Rotor.

CONTROL NO: 9203-A-C161  TYPE: CRDA  ACCEPTED: 04/17/92
LAB:  ASTD  ORTA POC: John Cline  PHONE NO.: 804-864-3966
COMPANY: McDonnell Douglas
PURPOSE: For experimental and analytical impact dynamics research for composite rotorcraft structures.

CONTROL NO: 9203-A-C160  TYPE: CRDA  ACCEPTED: 05/29/92
LAB:  ASTD  ORTA POC: John Cline  PHONE NO.: 804-864-3966
COMPANY: Bell Helicopter
PURPOSE: For research on composite flexures for rotor hub applications.

CONTROL NO: 9201-A-C143  TYPE: CRDA  ACCEPTED: 02/05/92
LAB:  ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Alpha Industries
PURPOSE: For development of novel semiconductor devices based on planar doped barrier structures.

CONTROL NO: 9111-A-C136  TYPE: CRDA  ACCEPTED: 12/19/91
LAB:  HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY: MCNC
PURPOSE: For development of a plasma assisted dry soldering procedures and equipment.

CONTROL NO: 9110-A-C128  TYPE: CRDA  ACCEPTED: 11/22/91
LAB:  ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: NJ Inst of Tech
PURPOSE: For development of ultra-high speed and millimeter wave electronic devices.

CONTROL NO: 9110-A-C126  TYPE: CRDA  ACCEPTED: 11/22/91
LAB:  ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Stevens Inst of Tech
PURPOSE: For R&D on optoelectronic device physics and engineering with applications to microwave and optical integrated circuits.

CONTROL NO: 9110-A-C125  TYPE: CRDA  ACCEPTED: 11/22/91
LAB:  ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Rutgers Univ
PURPOSE: For development of smart ceramic materials.
|-------------|------------|----------|---------------------|--------------------------|----------------------|-----------------------------------------------------------------|
CONTROL NO: 9101-A-P082 TYPE: PLA ACCEPTED: 01/23/91
LAB: ETDL ORTA POC: Dick Stern PHONE NO.: 908-544-4666
COMPANY: Ball Corp PURPOSE: For a partially exclusive license for a Dual Mode Quartz Thermometric Sensing Device, U.S. Patent No. 4,872,765.

CONTROL NO: 9101-A-P081 TYPE: PLA ACCEPTED: 01/23/91
LAB: ETDL ORTA POC: Dick Stern PHONE NO.: 908-544-4666

CONTROL NO: 9101-A-P080 TYPE: PLA ACCEPTED: 01/23/91
LAB: ETDL ORTA POC: Dick Stern PHONE NO.: 908-544-4666
COMPANY: Motorola, Inc PURPOSE: For a partially exclusive license for a Dual Mode Quartz Thermometric Sensing Device, U.S. Patent No. 4,872,765.

CONTROL NO: 9101-A-P079 TYPE: PLA ACCEPTED: 01/23/91
LAB: ETDL ORTA POC: Dick Stern PHONE NO.: 908-544-4666

CONTROL NO: 9101-A-P078 TYPE: PLA ACCEPTED: 01/23/91
LAB: ETDL ORTA POC: Dick Stern PHONE NO.: 908-544-4666

CONTROL NO: 9101-A-P077 TYPE: PLA ACCEPTED: 01/23/91
LAB: ETDL ORTA POC: Dick Stern PHONE NO.: 908-544-4666

CONTROL NO: 9101-A-P076 TYPE: PLA ACCEPTED: 01/23/91
LAB: ETDL ORTA POC: Dick Stern PHONE NO.: 908-544-4666
CONTROL NO: 9011-A-C073  TYPE: CRDA  ACCEPTED: 03/04/91
LAB: MTL  ORTA POC: Dr. Hamed El-Bisi  PHONE NO.: 617-923-5396
COMPANY: PPG Industries, Inc
PURPOSE: For characterization and possible further development of oxynitride glass fibers.

CONTROL NO: 9010-A-C071  TYPE: CRDA  ACCEPTED: 11/06/90
LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Norden Systems, Inc
PURPOSE: For development of a portable flat panel display workstation.

CONTROL NO: 9009-A-P066  TYPE: PLA  ACCEPTED: 11/29/90
LAB: HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY: Defense Res Tech

CONTROL NO: 9008-A-C062  TYPE: CRDA  ACCEPTED: 09/06/90
LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Rutgers Univ
PURPOSE: To advance the development of ultra high speed and millimeter wave electronic devices.

CONTROL NO: 9006-A-C056  TYPE: CRDA  ACCEPTED: 07/20/90
LAB: HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY: M/A-COM
PURPOSE: To perform cooperative research, test and evaluate the operation and damage characteristics of solid-state PIN diodes.

CONTROL NO: 9006-A-C055  TYPE: CRDA  ACCEPTED: 07/20/90
LAB: HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY: McDonnell Douglas
PURPOSE: To design, develop, evaluate and test Artificial Intelligence/expert computer software systems and their supporting technologies such as terrain reasoning.

CONTROL NO: 9006-A-C053  TYPE: CRDA  ACCEPTED: 07/12/90
LAB: HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY: Rockwell Intntl Corp
PURPOSE: To test and evaluate automated 3-D X-Ray equipment in a production environment.
CONTROL NO: 9005-A-C052  TYPE: CRDA  ACCEPTED: 07/02/90
LAB: HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY: Grumman Aerospace
PURPOSE: To test and evaluate an analog electronic device to clip or limit the amplitude of a transmission signal.

CONTROL NO: 9002-A-C038  TYPE: CRDA  ACCEPTED: 03/06/90
LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Martin Marietta Corp
PURPOSE: For development of a permanent magnet system for a microwave tube.

CONTROL NO: 8912-A-C036  TYPE: CRDA  ACCEPTED: 01/18/90
LAB: HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY: J&S Software Dvlpmt
PURPOSE: For development of systems operation software which would be applicable for large IMB compatible environments.

CONTROL NO: 8912-A-C035  TYPE: CRDA  ACCEPTED: 01/09/90
LAB: MTL  ORTA POC: Dr. Hamed El-Bisi  PHONE NO.: 617-923-5396
COMPANY: WAMDP, Inc
PURPOSE: For development of advanced automated manufacturing systems.

LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANIES: Emcore Corp; American Cyanamid; Polytechnic Univ
PURPOSE: To investigate how to improve the quality of OMVPE-grown structures and to attempt to find substitutes for highly toxic gases.

CONTROL NO: 8909-A-C029  TYPE: CRDA  ACCEPTED: 10/03/89
LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Martin Goffman Ascts
PURPOSE: For development of optical, infrared, and microwave detectors using superconducting technology.

CONTROL NO: 8909-A-C028  TYPE: CRDA  ACCEPTED: 10/06/89
LAB: HDL  ORTA POC: Norma Vaught  PHONE NO.: 301-394-2952
COMPANY: LTS Corp
PURPOSE: For development of a laser microscopy system for the commercial market.
CONTROL NO: 8908-A-C024  TYPE: CRDA  ACCEPTED: 09/22/89
LAB: MTL  ORTA POC: Dr. Hamed El-Bisi  PHONE NO.: 617-923-5396
COMPANY: Owens-Corning
PURPOSE: For conducting tensile testing and chemical analysis of specimens of novel oxynitride glass fibers.

CONTROL NO: 8908-A-C023  TYPE: CRDA  ACCEPTED: 09/22/89
LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: EMC Technology, Inc
PURPOSE: For designing, developing and evaluating high performance digitally programmable attenuators, components, circuits and subassemblies.

CONTROL NO: 8905-A-C018  TYPE: CRDA  ACCEPTED: 06/21/89
LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Res Triangle Inst
PURPOSE: For E-Beam Probing of Differential Cascode Voltage Switch (DCVS).

CONTROL NO: 8809-A-C005  TYPE: CRDA  ACCEPTED: 10/21/88
LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Electromagnetic Sci
PURPOSE: For millimeter wave high power ferrite control devices.

LAB: ETDL  ORTA POC: Dick Stern  PHONE NO.: 908-544-4666
COMPANY: Trontech
PURPOSE: For development of high frequency oscillators and amplifiers.

LAB: MTL  ORTA POC: Dr. Hamed El-Bisi  PHONE NO.: 617-923-5396
COMPANY: Dow Chemical
PURPOSE: For development of advanced ceramic engine components and advanced lightweight armor applications.
ARMY RESEARCH LABORATORY

Weapons Technology

Dr. John Frasier
Directorate Executive
Weapons Technology (WTD)
(410) 278-6244
The mission is detailed on this chart. Research is pursued in energetic materials dynamics, propulsion/flight physics, projectile/warhead mechanics, terminal effects phenomena, armor/survivability technologies, advanced munition/weapons concepts, nuclear weapons effects/survivability technologies, directed energy effects, low observable technologies and system effectiveness analysis. The primary customers are those who develop weapons systems which enhance the lethal defense posture. WTD supports the Army RDE Centers, other Commands, other Services, and various PEOs and PMs such as PEO Armored Systems Modernization, PEO for Intelligence and Electronic Warfare, PM for Tank Main Armament Systems and PM for Advanced Field Artillery Systems. Major efforts include support for the liquid propellant and unicharge candidate selection and studies on electro-thermal chemical propulsion.
This is as good as any way to quickly get an understanding of the current organization. While keeping the "traditional" ballistic mission of BRL, WTD has surrendered the high performance computing mission and the ballistic survivability/lethality assessment mission. Low observable technology and the nuclear and directed energy missions were added. We have already noticed some interesting collaboration opportunities as a result of these new communication channels in ARL.
WTD has a number of experimental test facilities, most of which are located on Spesutie Island in the flats of the Susquehanna River. They include energetics/explosive test facilities, high pressure facilities, shock tubes, a transonic ballistic facility, a closed facility for containing depleted uranium shot. The Adelphi Site of ARL houses the Aurora gamma ray facility and EMP simulators are located at the Woodbridge Site.
FLOW OF THE BRIEFING

Today I will start with two general funding charts. Then I will generally move left to right through the technical focus of each division. At the end I'll finish with a few real and immediate business opportunities that are important to us and may be of interest to you.
FUNDING PIE

By business area, you can see that the low observable technology area has significant current funding levels. The rest is relatively equally divided among the traditional ballistic and nuclear/directed energy lines.
FUNDING PROJECTIONS

If you care to have faith in future funding projections or in stable world political and economic events this may be of value. Only one comment here, the weapons concepts work which I will talk to later shows a trend upward from FY95-FY96.
Technical Focus

- RF/DIRECTED ENERGY WEAPON RESEARCH
  - HPM SOURCES, ANTENNAS, MODE CONVERTERS
  - COMPACT, RUGGED PULSE POWER SOURCES
  - HPM TESTING OF MILITARY SYSTEMS
  - HPM HARDENING TECHNOLOGY AND DEVICES
  - HPM WEAPONS EFFECTIVENESS MODELING

- NUCLEAR SURVIVABILITY RESEARCH
  - SURVIVABILITY ENHANCEMENT TECHNOLOGY
  - ELECTROMAGNETIC SHIELDING AND BLAST/ THERMAL RESPONSE OF NONMETALLIC MATERIALS
  - IMPROVED PREDICTION AND ANALYSIS CODES
  - SURVIVABLE ELECTRONICS AND MATERIALS

WEAPONS TECHNOLOGY DIRECTORATE
NDDED

The focus of NDED is listed here. Both the feasibility and effectiveness of DE weapons are of interest as well as measures to protect U.S. systems. This includes HPM sources, antennas and pulsed power, testing, modeling and hardening. Nuclear hardening of future systems includes state-of-the-art electronics and nonmetallic structures which pose a special challenge for prediction and analysis codes necessary to evaluate future weapons environments and design trade-offs.
Technical Focus

- Interior, exterior and transitional ballistics
- Mechanics and dynamics of projectiles
- Advanced projectile, propulsion and flight concepts for chemically and electrically-powered guns
- State-of-the-art models and design methodologies
- Transition of Projectile, Propulsion, and Flight Technologies to RDEC's, PEO's/PMs and Industry

WEAPONS TECHNOLOGY DIRECTORATE
PFD

Emphasis here is in the state-of-the-art models and design methodologies. Novel concepts being explored are low vulnerability propellants, electrothermal gun propulsion, drag-reducing propulsion for KE projectiles, bulk-loaded and regenerative liquid propellant guns, laser initiation for large caliber guns, ram accelerators, and composites for lightweight ballistics.
Lethality
  KE Penetrators
  Ballistic Shock Damage
Survivability
  Armors (Passive, Reactive, Special)
  Electromagnetic Armor
 Insensitive Munitions
  Ammunition Compartmentalization
Computational Terminal Ballistics
  Material Modeling
  Simulation of DE/EFP/KE Target Interactions
  Simulation of Advanced Armor Configurations
  Simulation of Vehicle Response to Ballistic Events

WEAPONS TECHNOLOGY DIRECTORATE
TED

Here we look at both sides of the lethality-survivability issue with a combination of experiments, models, theory, and simulations.
Technical Focus

- Active Protection Systems
- Hypervelocity Ballistics
- Hybrid In-bore Ramjet Technology
- Low Vulnerability Ammunition
- Robotics and Autonomous Systems
- Combat / Technology Simulations
- Generic Systems Effectiveness

WEAPONS TECHNOLOGY DIRECTORATE
WCD

Emphasis here is in the novel leap-ahead technologies and systems. If there is an area of growth or increased emphasis it is in weapons concepts and systems analysis. It is in this Directorate that you will find three of the ARL focus programs that were discussed by Mr. Vitali.
Key to the focus programs is the across ARL scope of the research. By bringing the diverse expertise of ARL together, novel future systems can be evaluated. We certainly cannot work in a vacuum in these areas and as you can see we want to get all the right technologists involved from other government labs and the private sector.
ARL Focus Programs

Advanced Artillery Technology

KEY PLAYERS

<table>
<thead>
<tr>
<th>ARL</th>
<th>Weapons Technology Directorate (Lead)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(VTD)</td>
<td>Human Research &amp; Engineering Directorate</td>
</tr>
<tr>
<td>(BED)</td>
<td>Battlefield Environment Directorate</td>
</tr>
<tr>
<td>(SIO)</td>
<td>Sensors, Signatures, Signal &amp; Information Processing Directorate</td>
</tr>
<tr>
<td>(MATD)</td>
<td>Materials Directorate</td>
</tr>
<tr>
<td>(SLAD)</td>
<td>Survivability/Lethality Analysis Directorate</td>
</tr>
</tbody>
</table>

Other Army

<table>
<thead>
<tr>
<th>ARL</th>
<th>Artillery Center &amp; School</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ARDEC)</td>
<td>Armament RDE Center</td>
</tr>
<tr>
<td>(MICOM)</td>
<td>Missile Command</td>
</tr>
<tr>
<td>(AMSSA)</td>
<td>Army Materiel Systems Analysis Agency</td>
</tr>
<tr>
<td>(SARDA)</td>
<td>Office of Secretary of the Army (OASA)</td>
</tr>
</tbody>
</table>

Other Government

<table>
<thead>
<tr>
<th>ARL</th>
<th>Sandia National Laboratories</th>
</tr>
</thead>
</table>
ARL Focus Programs

Autonomous Systems
Science and Technology

KEY PLAYERS

ARL

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WTO</td>
<td>Weapons Technology Directorate (lead)</td>
</tr>
<tr>
<td>HRED</td>
<td>Human Research &amp; Engineering Directorate</td>
</tr>
<tr>
<td>SND</td>
<td>Sensors, Signatures, Signal &amp; Information Processing Directorate</td>
</tr>
<tr>
<td>EPSD</td>
<td>Electronics &amp; Power Sources Directorate</td>
</tr>
</tbody>
</table>

Other Army

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRDEC</td>
<td>Chemical RDE Center</td>
</tr>
<tr>
<td>TACOM</td>
<td>Tank-Automotive Command</td>
</tr>
<tr>
<td>CSTA</td>
<td>Combat Systems Test Activity</td>
</tr>
<tr>
<td>TADC</td>
<td>TACOM Army Depot</td>
</tr>
<tr>
<td>CAC</td>
<td>Combined Arms Center</td>
</tr>
</tbody>
</table>

Other Government

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JPO-UGV</td>
<td>Joint Project Office for Unmanned Ground Vehicles</td>
</tr>
<tr>
<td>ORNL</td>
<td>Oak Ridge National Laboratory</td>
</tr>
<tr>
<td>NIST</td>
<td>National Institute for Standards &amp; Technology</td>
</tr>
<tr>
<td>JPL</td>
<td>Jet Propulsion Laboratory</td>
</tr>
</tbody>
</table>

Industry

<table>
<thead>
<tr>
<th>Company</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMC</td>
<td>FMC Corporation</td>
</tr>
<tr>
<td>Gdeics</td>
<td>Gdeics, Inc.</td>
</tr>
<tr>
<td>Alliant</td>
<td>Alliant Tech. Inc.</td>
</tr>
<tr>
<td>DST</td>
<td>Dynamic System Technology, Inc.</td>
</tr>
</tbody>
</table>
BROAD AGENCY ANNOUNCEMENT

Low Observable Technology
High Power Microwave Technology
Non-nuclear EMP Technology
Nuclear Survivability

The Weapons Technology Directorate topics in the current BAA are limited to the Low Observable Technology Office and the Nuclear/Directed Energy Division areas of interest. 10 research areas are related to low observables, 5 are in the radio frequency directed energy area and 3 involve nuclear survivability research. These topics are open through September 30, 1993. Instructions on how to submit proposals are in the solicitation.
The next SBIR solicitation is concerned with the above subjects. We are striving to make progress in terminal ballistics as we did in the free flight computational fluid dynamics. Active protection systems need to consider electromagnetic launch rather than explosive launch and the associated problems. A quick-look to get an idea of the effectiveness of a weapons system against a helicopter before an in-depth assessment is made would be a useful evaluation tool.
COOPERATIVE R&D OPPORTUNITIES

Laser Technology Applications
Computational Fluid Dynamics
Explosive Synthesis of Ceramics
New Technologies, Weapons & Concepts
Composites

Technology applications in WTD do not often directly relate to commercial products of great economic importance, however we do contribute to the state-of-the-art in several areas. Here is a list of a few technologies we feel are suitable for joint pursuit. A variety of teaming approaches are possible. If we can leverage our R&D money with outside talent and resources, get a better defense product, and help the economy of the country, or maintain the technical infrastructure, WTD is definitely interested in talking with you.
INTERFACE w/ ARL @ APG

Advanced Concepts and Plans (ACAP)
Technology Transfer Division

Rich Dimmick           Mike Rausa
(410) 278-6955       (fax) 278-7962

- Industry Programs
- Commercialization of Technology

If you need to know more about opportunities with ARL, Directorates located at Aberdeen Proving Ground or any of the technologies mentioned in the briefing, the Technology Transfer Division is the best place to start.
S3I MISSION

Conduct research to create sensor and signal/data processing technologies and concepts capable of adaptive operation and automated fusion as well as supporting real-time information distribution to enable the Army to acquire, locate, identify and engage the enemy in real time and under all battlefield environmental conditions.
Sensor technology developed by S3I enables the detection and engagement of enemy forces. Specific applications developed here include:

- MTI radar for unmanned aerial vehicles
- Synthetic Aperture Radar
- Millimeter Wave Radar
- Guidance Integrated Fuzing

To support the development of advanced sensors and algorithms for future weapon systems, we are researching techniques to improve signature prediction for FLIR, visible, MMW, LADAR, radar, and SAR sensors. As the complexity and degree of these advanced sensor systems increase, the importance of signature modeling in controlling the costs of testing these system concepts becomes significant.
Optical processing modules provide high throughput capability in compact packages. When configured in hybrid optical/digital systems, real-time operation can be achieved for radar, communications, and target recognition applications.

The battlefield commander's staff needs to gather, integrate, and process combat information. We have designed the Combat Information Processor and the AI Module to integrate near-real-time information from many sensors and sources to assist the battlefield commander in the decision making process.
S3I performs engineering development and production support for fuzes on a selective basis. Fuzes developed here include:

- PATRIOT (M818E2)
- Chaparral (M817E1)
- MOFA (XM773)
- M732A2
- M734E1

**S3I CONTRACT PLAN**

![Bar chart showing SK availability from 1993 to 1996]
Real Aperture Stationary Target Radar - Detect, discriminate, and classify stationary targets using a low depression angle real aperture radar.

Moving Target Radar Technology - All-weather long-range wide area detection, location, and classification of moving targets.

Ultra Wideband Foliage Penetration Synthetic Aperture Radar - All-weather, wide area detection, location and classification of stationary tactical ground targets concealed by foliage, including surface and buried mines.

Jeffrey Sichina, (301) 394-2530
U.S. Army Research Laboratory
ATTN: AMSRL-SS-SG
2800 Powder Mill Road
Adelphi, MD 20783-1145
PHOTONIC PROCESSING

Develop and demonstrate optical techniques, devices, and modules for real-time, high throughput signal processing applications, with module integration into processing systems.

Research efforts focused in these areas: diffractive optics, optical scale-space processing, higher order statistics, photorefractive processors, integrated photonic processing systems, and coherence and photonic processing.

Dr. John Pellegrino (301) 394-2520
U.S. Army Research Laboratory
ATTN: AMSRL-SS-SF
2800 Powder Mill Road
Adelphi, MD 20783-1145

PHOTONIC PROCESSING FUNDING

FY 93

$2,767K In-house
$2,507K Contract (unavailable)

FY 94-96

$386K Contract (available)
$10,288K In-house
$3,042K Contract (unavailable)
Develop and maintain cognizance of signature data, sensor, and signal processing technology efforts throughout the DoD community. Identify and recommend appropriate balance of these efforts and emphasize the most promising technical approaches to new sensor and signal processing technology for next generation automated sensor systems.

Dr. Norman Berg, (301) 394-2500
U.S. Army Research Laboratory
ATTN: AMSRL-SS-M
2800 Powder Mill Road
Adelphi, MD 20783-1145

Battlefield Acoustic Technology

$910K In-house
$1.136K Contract (unavailable)
$2.395K In-house

$250K Contract (available)
$395K Contract (unavailable)

FY 93
FY 94-96
TARGET ACQUISITION & BATTLE MANAGEMENT

ARL Focus Program -- S31 has lead

Technology Areas:

Ultra Wideband Synthetic Aperture Radar Technology
EO/Radar Sensor Technology for Multi-sensor Stationary Target Indication
Radar Sensor Technology for Multi-sensor Moving Target Indication
Ground-based Passive Multi-sensor ID & Classification Technology
Staff Tactical Operations Center Work Station

S31 SMALL BUSINESS INNOVATION RESEARCH
FY 93 Funding and Topics

$1,980K

Signal Processing $654K
Radar/Sensors $727K
Fuzing $399K
Electronics Assy/Inspect $200K

Impulse radiating antenna
Digital waveform generator
Angular rate sensor
Electronically scanned antenna
Knowledge-based target classification
Oxygen pump for low noise fluidics
RF diode laser modulator
Multi-layer microstrip antenna
Acceleration sensing module
GPS frequency translator IC

Miniature RF filters & low power oscillators
Low power MMIC
Surface-relief diffractive lenses
PC-based diffractive optical element mask generator
Laser pattern generator for diffractive optical elements
Noise filters
Microscale fluid devices
High speed solder paste printer
Panoramic image translation of microelectronic assy
Automated composite inspection system
FY93 BROAD AGENCY ANNOUNCEMENT

Materials
Device and Modules
Processing Algorithms
Novel Optical Processing Systems
Optical System Performance
High-Density DSP Circuitry
Analog/Digital Conversion
Frequency Selective Filter
RF Signal Processing
Advanced Acoustic Sensors
Automatic Target Recognition
Artificial Intelligence
Multistatic Radar Technology
Safety and Arming Systems
Sensors
Signal Processing
Global Positioning System
Environmental & Interior Ballistic Simulation

John Pellegrino, (301) 394-2520
John Pellegrino, (301) 394-2520
John Pellegrino, (301) 394-2520
John Pellegrino, (301) 394-2520
Mike Panerson, (301) 394-2520
Mike Panerson, (301) 394-2520
Mike Panerson, (301) 394-2520
Mike Panerson, (301) 394-2520
Mike Panerson, (301) 394-2520
Bruce Weber, (301) 394-2500
Mark Hamilton, (703) 704-1677
Philip Emmerman, (301) 394-3000
Mike Kolodny, (301) 394-3110
Greg Sztankay, Bill Konick
(301) 394-3130, (301) 394-2525

POINTS OF CONTACT

Broad Agency Announcement
Unsolicited Proposals
SBIR
SBIR (S3I)
Small & Disadvantaged Business
Competition Advocate
Technology Transfer
Technology Transfer (S3I)
Public Affairs

Beth Bowen, (301) 394-2964
Mel Shichtman, (301) 394-5075
Dean Hudson, (301) 394-4808
Shirley Corbett, (301) 394-4602
Tom Rodgers, (301) 394-1076
Mary Ellen Caldwell, (301) 394-3882
Mike Claffy, (301) 394-4210
Norma Vaught, (301) 394-2952
Marian Singleton, (301) 394-3590
Combat Identification Briefing

to

APBI

28 January 1993
Mr. Dick Slife
ARL S31D
MISSION

From GEN Sullivan:

Pull Together and Establish a TRADOC/AMC Task Force (TRADOC LEAD) to lay out a Comprehensive Army Program, addressing both short and long term requirements and solutions, and detailing the interfaces necessary with other Services and Allies. For near term, concentrate on tactical level for surface-to-surface and air-to-surface. For far term, expand on operational level and include air-to-air and surface-to-air.

"The Army cannot accept casualties that can be prevented by our own actions to improve identification in combat."

"I want to make sure that we are properly organized to focus our efforts in this area."

COMBAT IDENTIFICATION CONCEPT

- Improved Situational Awareness
  - Mission, Enemy, Terrain, Troops - Time
  - Know Where I Am
  - Know Other Friendly Locations
  - Know Neutral and Enemy Locations

- Improved Target Identification
  - Thru-Sight Target ID Indication to Maximum Weapons Range
  - Make Less Sensitive to the Environment
  - Work for Passive, Non-Cooperative Identification
Architecture for CID System

Target Identification:
- Reagents: Shooter: Active
  Target: Active-Cooperative
  ID: Friend, Unknown
- Approach: MMW Question & Answer Sys
  Mounted (Ground Based)

Situational Awareness:
- Reagents: Self Location
  Heading
  Approach: GPS
- Reagents: Enhanced Platform Display
  PIP Near Term if Practical
  Dismounted Soldier
- Approach: TBD

INTEGRATED COMBAT IDENTIFICATION:
- Reagents: Shooter: Enhanced Active or Passive
  Target: Cooperative
  ID: Friend, Unknown
- Approach: TBD

Combat ID Materiel Program Plan

Calendar Year
- CY90
- CY91
- CY92
- CY93
- CY94
- CY95
- CY96
- CY97
- CY98
- CY99

Fiscal Year
- FY91
- FY92
- FY93
- FY94
- FY95
- FY96
- FY97
- FY98
- FY99
- FY00

Quick Fix

Current

Near Term

Mid/Far Term

Supporting Technologies
Battlefield Combat Identification
Program Summary

**CECOM POC:**
- **Objective:**
  - Quick Fix - Go To War Capability in 1 Year
  - Quick Fix Plus - POS/NAV Situational Awareness and Thermal TGT ID Device (TID) 18 Months
  - Near Term - Enhanced TGT ID 3 Years
  - Mid/Far Term - Integrated Imbedded TGT ID/Situational Awareness System by FY2000
- **Technical Approach:**
  - Quick Fix - IR Lights, Thermal Tape
  - Quick Fix Plus - SLGR/PLGR, Compass, TID
  - Near Term - Enhanced Active, Passive
  - Mid/ Far Term - Enhanced Active/Passive Cooperative ID, Active or Passive Non-Cooperative ID; Integrated, Imbedded TGT ID/Situational Awareness

**ARL Task Leader:**
- Combat Identification
- Situational Awareness Plus Target Identification Increases Combat Effectiveness

**Tactical Concept**

| Year | Funding
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>94</td>
<td>6.2</td>
</tr>
<tr>
<td>95</td>
<td>5.0</td>
</tr>
<tr>
<td>96</td>
<td>5.0</td>
</tr>
<tr>
<td>97</td>
<td>5.0</td>
</tr>
<tr>
<td>98</td>
<td>4.9</td>
</tr>
</tbody>
</table>

**Plans/Status:**
- Quick Fix - Complete Development Integration
- Quick Fix Plus - FY92 Tech DEMO FY93-94 Development/Integration
- Near Term - FY92 Tech DEMO, FY93-94 EMD FY95-96 Production/Fielding
- Mid/ Far Term - FY92 M50, FY93 Concept Exploration FY94-96 ATO, FY96 EMD, FY98 Production

**Buddy Light - Infrared Transmitter**
- Near IR
- Ground-to-Ground ID
- DARPA Light - Anti-Fraintroid Infrared Device
- Near IR
- Air-to-Ground ID
- Thermal Tape - Low Emissivity Tape
- Far IR
- Ground-to-Ground ID

**Battlefield Combat Identification Quick Fix**

**ARL Task Leader:**
- Far IR
- Near IR
- BUDD Light
- DARPA Light
- Thermal Tape
- Total PROC

**CECOM POC:**
- **Objective:**
  - Go To War Capability in 1 Year
- **Technical Approach:**
  - BUDD Light - Infrared Transmitter
  - Near IR
  - Ground-to-Ground ID
  - DARPA Light - Anti-Fraintroid Infrared Device
  - Near IR
  - Air-to-Ground ID
  - Thermal Tape - Low Emissivity Tape
  - Far IR
  - Ground-to-Ground ID

**Buddy Light**
- Fast Flash Model - DLA Inventory
- Slow Flash Model - Army CISP/Control
- FY93 - Contract Option Awarded
- DARPA Light
- 7200 in Army CISP/Control Inventory
- No Plan to Acquire Additional Quantities

**Technical Issues:**
- Thermal Tape - Gloss

**Performing Activities:**
- ARL
- BRODEC
- NVEO

28 JAN 93
## Battlefield Combat Identification
### Near Term Program

**ARL Task Leader:**

**CECOM POC:**

**Objective:**
Enhanced Target ID Capability in 3 Years

**Technical Approach:**
- MMW Q&A

### Funding

<table>
<thead>
<tr>
<th></th>
<th>93</th>
<th>94</th>
<th>95</th>
<th>96</th>
<th>97</th>
<th>98</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3A</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.3B</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Performing Activities:**
- PM C/D
- ARL
- CE-TO

**Plans/Status:**
- FY92 - Technology Demonstration
- FY93-94 - EMD
- FY95-96 - Production and Fielding

**Technical Issues:**
- Army Combat Aviation Platforms

---

## Battlefield Combat Identification
### Quick Fix Plus

**ARL Task Leader:**

**CECOM POC:**

**Objective:**
- Provide POS/NAV Situation Awareness and Thermal Target ID Device in 18 Months
  - SLGR/PLGR
  - Compass
  - Target ID Device

**Technical Approach:**
- SLGR/PLGR Integration for M1A1/A2/M3/M4/MW
- Select Compass Integration for M1A1/M2/M3
- Thermal ID Device
  - Laser Activated
  - Far IR

### Funding

<table>
<thead>
<tr>
<th></th>
<th>93</th>
<th>94</th>
<th>95</th>
<th>96</th>
<th>97</th>
<th>98</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.7</td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROC</td>
<td></td>
<td>6.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Performing Activities:**
- ARL
- PM Abrams
- BROE
- PM Bradley
- TACOM
- PM GPS
- PM NVEO

---

28 JAN 93
Battlefield Combat Identification
Mid/Far Term Program

ARL Task Leader:

CECOM POC:

Objective
Integrated, Imbedded Situational Awareness/Target ID Capability by FY2000

Technical Approach
- Enhanced Active Cooperative ID System
- Passive Cooperative ID System
- Active or Passive Non-Cooperative ID System

Planned/Status
- FY92 - MS "0"
- FY93 - Concept Exploration
- FY94 - ATD
- FY96 - EMD
- FY98 - Production

Technical Issues
- Active/Passive NCTR
- Data Fusion
- Data Distribution/Display

Performing Activities:
ARL
CECOM
PM-CID
PEO-IEW
PEO-ASM
PEO-AVN
PEO-Comm
PEO-Combat SPT

Architecture Study

ARL Task Leader:

CECOM POC:

Project Objectives:
- Define Primary Mid and Far Term Combat ID System Architecture Options
- Determine Key Technologies for Development
- Determine S&T Investment Plan for Combat ID
- Provide Technical Foundation for COEA

Technical Objectives:
- Determine Measures of Effectiveness and Technical Risks of Candidate Technologies
- Investigate Integration with Existing and Developmental Systems/Platforms
- Investigate Situational Awareness and Target ID Synergy
- Manage with Government Steering Committee

Activity
SOW
Award
IPR
Prelim Rpt
Final Rpt

Schedule
FY93
FY94
Far Term CID Tech Base

Leverages Ongoing Technology Programs In:
- Automated Target Recognition Algorithms
  - Acoustic
  - EO
  - Radar
  - Multi-Sensor
- Photonic Processing
- Scalable Digital Processing Architectures
- Advanced Sensor and Processor Component Technology
- Display Technology
- Human Factors Research
- LO Target Modelling

Summary

Combat ID Program Must:
- Provide Robust Combination of Integrated Target ID and Situational Awareness
- Develop Technologies Which Provide High Confidence and Low Vulnerability Solutions
- Provide Affordable Solutions Which Can Be Integrated Across the Force
- Maximize Dual Use Capabilities (i.e. Acquisition, Survivability, C2)
- Provide Tools Which Can Assess Operational Effectiveness of Potential Solutions
Mr. Lawrence D. Johnson
Directorate Executive
Materials Directorate (MAT)
(617) 923-5275
• MTL → ARL MATERIALS DIRECTORATE
• FUNDING PROFILE AND INVESTMENT STRATEGY
• WORKING TOGETHER
• TECHNOLOGY AREA HIGHLIGHTS
• “1-800-MATERIALS”

Mission

Provide the United States Army with a technology edge by research, development, processing and manufacturing technology, and standardization of superior materials.
MATERIALS DIRECTORATE - APB!
TRANSITION

1993 - 1995
"YEARS OF CHANGE AND CHALLENGE"

THE MATERIALS DIRECTORATE WILL:

- CHANGE ITS CORPORATE IDENTITY FROM MTL - TO ARL
- CLOSE DOWN A MAJOR FACILITY (WATERTOWN)
- BUILD A NEW, WORLD CLASS LABORATORY (ABERDEEN)
- MAINTAIN AN ONGOING, HIGHLY FOCUSED, PRODUCTIVE IN-HOUSE AND EXTERNAL R&D PROGRAM - WITHIN A HIGHLY CONSTRAINED BUDGET
Assets: Personnel

Staff of 321

Skill Mix
73% Technical
18% Professional Support
8% Admin/Clerical

= 92% Professional

Educational Profile - Scientists & Engineers
14% Bachelors Degree
40% Masters
46% PhD's

= Well Educated

Federal Experience Profile
0 - 9 years -- 43.7%
10 - 19 years -- 21.1%
20 - 29 years -- 17.6%
29+ years -- 17.6%

Average age 44
MATERIALS DIRECTORATE - APBI
ANTICIPATED REVENUES ($M)

<table>
<thead>
<tr>
<th></th>
<th>FY '93</th>
<th>FY '94</th>
<th>FY '95</th>
<th>FY '96</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>4.5</td>
<td>3.6</td>
<td>3.8</td>
<td>3.8</td>
</tr>
<tr>
<td>6.2</td>
<td>17.0</td>
<td>16.5</td>
<td>16.9</td>
<td>17.5</td>
</tr>
<tr>
<td>6.3</td>
<td>1.3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OTHER</td>
<td>3.8</td>
<td>3.8</td>
<td>3.7</td>
<td>3.9</td>
</tr>
<tr>
<td>CUSTOMER (EXCLUDING DIRECT CITE CONTRACTS)</td>
<td>6.3</td>
<td>7.3</td>
<td>4.9</td>
<td>4.4</td>
</tr>
<tr>
<td></td>
<td>32.9</td>
<td>31.2</td>
<td>29.3</td>
<td>29.6</td>
</tr>
</tbody>
</table>

FY '93 - FY '96 ANTICIPATED EXPENDITURE PROFILE

84% IN-HOUSE
15% R&D CONTRACTS
1% OGA
CORE COMPETENCIES
(BUSINESS AREAS)

AREA
- ARMOR/ANTI-ARMOR
- HI TEMPERATURE MATERIALS
- MATERIALS FOR LT. WEIGHT STRUCTURES
- ENVIRONMENTAL DURABILITY
- MATERIALS PROCESSING & MANUF. TECH.
- SPECIAL FUNCTION MATERIALS
  - CHEMICAL & LASER PROTECTION
  - SIGNATURE REDUCTION
  - EM & OPTICAL MATERIALS

AREA MANAGER(S)
- DR. BISHOP/MR. DOWDING
- DR. FLETCHER
- MR. HASKELL
- DR. HAGNAUER
- DR. ADLER
- DR. KATZ

MATERIALS DIRECTORATE - APBI
FY '93 - '96 INVESTMENT STRATEGY
BY BUSINESS AREAS
HOW TO WORK WITH THE MATERIALS DIRECTORATE

GIVEN AN ENVIRONMENT OF CONSTRAINED FISCAL RESOURCES - "HOW CAN WE WORK TOGETHER TO CONTINUE TO DEVELOP TECHNOLOGY FOR THE ARMY'S FUTURE?"

- CRDA's
  MATCH OUR STRENGTHS WITH YOUR NEEDS

- UNFUNDED STUDIES
  JOINT R&D PROJECTS - EACH PARTY PERFORMS ITS PORTION AT ITS OWN EXPENSE (AUTHORITY AR-70, PARA 2-3)

- BAA
  TRADITIONAL CONTRACT MODE

- SBIR's

- UNIVERSITY - INDUSTRY - GOVERNMENT CONSORTIA (A MULTI-PARTICIPANT VERSION OF THE UNFUNDED STUDY)

HIGHLIGHTS OF THE TECHNICAL PROGRAM
SUCCESS TO DATE:

For Light-to-Medium Class (IFV) Hull

- Completed materials development, FEA design, process identification, fabrication of IFV hull
- Completed static and dynamic test; outfitted and 6000-mi. field tested
- Delivered validated materials data package supporting CAV et al

RESULTS

LIGHTWEIGHT — 25% weight savings for hull & armor
HIGHER SURVIVABILITY — 99% elimination of spall & better blast resistance
LOWER SIGNATURE & CREW STRESS — 5-10 dBA less noise, less vibration
LESS LOGISTICS BURDEN/COST — lower maintenance than metals

SUCCESS TO DATE:

For Medium-to-Heavy (40-55 ton) Hull

- Completed materials development, design, process ID
- Fabricated one heavy-class hull

FUTURE PLANS:

- Outfit and field test
- Transfer validated technology to TACOM/Industry
MATERIALS DIRECTORATE - APBI
PROCESSING & MANUFACTURING TECHNOLOGY
“SMART” WEAVE

SENSORS MOUNTED AS ROVING THREADS

PROVIDES:
- 3-D FLOW & CURE MONITORING DURING RESIN TRANSFER MOLDING OF THICK SECTIONS
- EMBEDDED SENSORS FOR IN-SERVICE CONDITION MONITORING

+ TECHNOLOGY HAS BEEN DEMONSTRATED (GLASS FIBER PREFORM, C-FIBER GRID, POLYESTER)

+ PATENT HAS BEEN ALLOWED

U-SHAPED Q vs. t CURVE ENABLES CURE MONITORING

SHOWS FLOW MONITORING (MOLD FILL MONITOR) MODE (i.e., ADVANCING RESIN FRONT)

MATERIALS DIRECTORATE - APBI
ARMOR
LOW COST Ti-ALLOY FOR ENHANCED COMPOSITE HULL

Titanium
Lightweight, 40% Lighter than Steel
Low Cost, $6 to $7/Lb vs. $20/Lb
Ballistically Tolerant
Structural Integrity
No Major Technological Barriers
Need To Optimize:
Ballistic Performance
Weldability
Mechanical Properties

Current Application
Commander’s Hatch, BFV

Possible Applications
Armor
Structure
Suspension System
Track
MATERIALS DIRECTORATE - APBI
ANTI-ARMOR
TUNGSTEN PENETRATORS

OPPORTUNITIES/BENEFITS

- COST AVOIDANCE OF DU CLEAN-UP IN FUTURE ACTIONS (EST. COST OF $1/2 BIL. FOR KUWAIT)
- ELIMINATE ISSUES ASSOCIATED WITH MANUFACTURING & FIELDING α-EMITTING MATERIAL
- EQUAL BALLISTIC PERFORMANCE TO DU APPEAR TO BE ATTAINABLE

SHEAR LOCALIZATION (ADIABATIC SHEAR)

STATUS

- IMPORTANCE OF ADIABATIC SHEAR IN PENETRATOR PERFORMANCE IS UNDERSTOOD
- IDENTIFIED CANDIDATE W-COMPOSITE SYSTEMS TO PROMOTE ADIABATIC SHEAR
- NiFe_{12}Al_{49} MATRIX PROMOTES HIGHLY LOCALIZED SHEAR IN TEST SAMPLES

NEEDS

- LOW COST PROCESSES
- FULLY DENSE MATERIAL
- PROCESSING TECHNOLOGY FOR NON-TRADITIONAL W-ALLOYS & COMPOSITES

MATERIALS DIRECTORATE - APBI
MATERIALS DURABILITY
CORROSION RESISTANT COATING FOR DU-3/4Ti PENETRATORS

- Potential applications: 919, 929 projectiles
- Al-Zn Alloy deposited by cathodic arc plasma PVD
- Provides galvanic protection to DU-3/4-Ti alloy
- Sacrificial coating can tolerate defects
- Exhibits better mechanical strength, adhesion and cohesion, than the other leading candidate coating

COATING | COHESIVE LOAD | ADHESIVE LOAD
---------|---------------|-------------------
Al-Zn    | 43.72 N       | 68.64 N           |
TiN-Ti-TIN | 27.18 N       | 32.55 N           |

Corrosion and pitting on 105mm M833 penetrator buttress grooves after 6 years of field exposure in European theater

M919 DU-3/4-Ti penetrator coated with Al-Zn
MATERIALS DIRECTORATE - APBI
MULTI-FUNCTIONAL MATERIALS
CERAMIC PHASE SHIFTER MATERIALS

- DEVELOPED A FAMILY OF CERAMIC COMPOSITES/DOPED $\text{Ba}_x\text{Sr}_y\text{TiO}_3$’S WITH TAILORABLE DIELECTRIC PROPERTIES

- COMBINATION OF $\varepsilon$, $\tan \delta$, TUNABILITY & REPRODUCIBILITY SUPERIOR TO PREVIOUS MATERIALS

MAT-DIR IS:
- SUPPLYING MATERIALS TO ESP-DIR FOR USE IN ELECTRO-OPTIC DISCRETE ELEMENT PHASE SHIFTERS
- SUPPLYING MATERIALS TO CECOM FOR ANTENNA DEVELOPMENT
- APPLYING FOR PATENT
- IN VARIOUS LEVELS OF CRDA NEGOTIATION/DISCUSSIONS WITH SEVERAL RADAR MANUFACTURERS

FROM BABBITT, KOSCICA, & DRACH
MICROWAVE J., JUNE 1992, p-63

PROGRAM FOCUS
EFFECTS OF CHEMICAL AGENTS AND DECONTAMINANTS ON PERSONNEL AND VEHICLE MATERIALS
DEVELOPMENT OF ADVANCED CLOTHING MATERIALS, PROTECTIVE COATINGS, NON-CORROSIVE DECONTAMINANTS AND SELF-DECONTAMINATING MATERIALS

BARRIER MATERIALS
POLYURETHANES
POLYSILICONES
BUTYL-RUBBERS
FLUORO-ELASTOMERS
POLYMER-BLENDS

APPLICATIONS
MASKS
HOODS
GLOVES
BOOTS
SEALS
COATINGS (rigid & flexible)
MATERIALS DIRECTORATE - APBI
GENERIC NEEDS

- QUALITY ASSURANCE & NDE TECHNOLOGY
- JOINING - ESPECIALLY DISSIMILAR MATERIALS
- LOWER COST PROCESSING
- FUNDAMENTAL UNDERSTANDING OF MATERIALS DEFEAT MECHANISMS
  - BALLISTIC
  - CHEMICAL AGENT PERMEATION
  - WEAR & CORROSION
- REPAIRABILITY
- STANDARDIZATION

MATERIALS DIRECTORATE - APBI
HOW TO REACH US:
MA-D KEY STAFF

Mr. Lawrence Johnson  AMSRL-MA  (617) 923-5275
Director

Dr. Gordon A. Bruggeman  AMSRL-MA-T  (617) 923-5351
Associate Director

Dr. Hamid El-Bai  AMSRL-MA-T  (617) 923-5396
Chief Scientist (Tech Transfer POC)

Dr. Robert Nathan Katz  AMSRL-MA-T  (617) 923-5527
Chief Technologist
Multi-Functional Materials, Area Manager

Dr. Gary Hagneuer  AMSRL-MA  (617) 923-5121
Sr. Scientist
Materials Durability, Area Manager

Dr. George Bishop  AMSRL-MA-M  (617) 923-5742
Chief, Mechanics Division
Armor Materials, Area Manager

Dr. Bernard Halpin  AMSRL-MA-P  (617) 923-5349
Chief, Polymers Division

Dr. Eric Kule  AMSRL-MA-M  (617) 923-5469
Chief, Metals Division

Dr. Dennis J. Viechnicki  AMSRL-MA-C  (617) 923-5295
Chief, Ceramics Division

Mr. John Dignam  AMSRL-MA-B  (617) 923-5519
Chief, Ballistic Missile Defense Materials Office

Dr. Ralph Adler  AMSRL-MA-MA  (617) 923-5469
Processing & Manufacturing Science, Area Manager

Mr. Robert Dowding  AMSRL-MA-MA  (617) 923-5340
Anti-Armor Materials, Area Manager

Dr. Martha Fletcher  AMSRL-MA-C  (617) 923-5049
Hi Temperature Materials, Area Manager

Mr. William Haskell  AMSRL-MA-PA  (617) 923-5172
Lightweight Structures, Area Manager

Mr. Robert Morrisey  AMSRL-CP-PP  (617) 923-5522
SBIR Program Manager
The Vehicle Propulsion Directorate, collocated at the NASA Lewis Research Center, has been the Army Aviation community's focal point for basic research and advanced development programs on gas turbine engines and power transmission systems. With its inclusion into the Army Research Laboratory complex, our mission has been expanded to include ground vehicle propulsion system research, already an element of our NASA host's mission. Our programs originate in a laboratory environment which has fostered the growth of recognized experts in their fields. Our established partnerships, providing access to world-class facilities, experts and capabilities, enables the VPD to fill the Army's vehicle propulsion research and technology niche.
The Vehicle Propulsion Directorate is located at the NASA Lewis Research Center, adjacent to the Cleveland Hopkins Airport in Cleveland, Ohio. NASA Lewis, as part of its charter, defines and develops advanced technology directed at propulsion and power for application to aeronautics. As a result, the Vehicle Propulsion Directorate has at its disposal a significant portion of the more than 100 buildings and 550 specialized research rigs and internationally recognized researchers devoted to scientific and engineering research excellence. Since its founding in 1970, the VPD has emphasized interests of Army Aviation, due to our origination in the Army Aviation Research and Development community. The Directorate has, however, participated in propulsion work for other than air vehicles at the request of other government agencies and also through involvements with our NASA hosts. Under the Army Research Laboratory, our ground vehicle propulsion emphasis will grow. This has begun through expansion of existing NASA programs and resurrection of previous Propulsion Directorate activities.
The work product of the Vehicle Propulsion Directorate is advanced propulsion technology derived through the conduct of a strong tech base program. Program drivers may be traced back through Airland Operation, to the Army Warfighting Requirements, and even to the major Science and Technology thrusts. The objective of advancing technology for higher power density and lower fuel consumption vehicle propulsion systems is addressed by conducting airbreathing propulsion and drive train research and development programs which support the goals of the Integrated High Performance Turbine Engine Technology (IHPTET) program, Advanced Mobility Systems and the Advanced Rotorcraft Transmission (ART) program.
The ultimate customer of the Vehicle Propulsion Directorate is the soldier in the field. Our work product generally reaches the soldier from the PEO/PMs by way of the Research and Development Engineering Centers (RDECs) or the industry. The VPD traditionally works with the RDECs on the solution of field and developmental problems, component improvement activities and upgrades. Our involvement with industry is most often through shared links in the tech base programs, whether in the form of technical reports or in cooperative programs. On occasion, support is also provided directly to the PEO/PMs through participation on boards and assistance during system qualification programs.
The Vehicle Propulsion Directorate is structured as shown with two technical divisions, a support division and an integration office supporting the director. The Technology Integration Office, not yet staffed, will operate as the interface between the VPD and the RDECs. Their coordination will assist the directorate in establishing the direction of new technical programs. The Support Division provides administrative program management and technical program management services, as well as technical support, to ensure the continued conduct of a propulsion research activity at the VPD in concert with our NASA hosts. Technical programs are managed and/or conducted by individual Army scientists and engineers, from either the Engine Components Division or the Engine and Transmission Systems Division, operating within the framework of the NASA Lewis Research Center's organizational units. Technical activities range from analytical code development, analyses and investigations, to component testing, to complete system experiments in all areas relating to vehicle propulsion. Component and system experiments are performed in-house in NASA owned rigs. Programs are generally conducted with the investment of both Army and NASA resources.
The Vehicle Propulsion Directorate plans, manages, and executes basic research and exploratory development programs of the Army Research Laboratory aimed at vehicle propulsion concepts, components, and systems technology. The programs are both in-house research and contracted activities. Significant activity and progress has been seen in gas turbine engine and power transfer technologies over the past 20+ years. Advances such as utilization of PMR-15, active compressor stabilization, compliant layer strain isolation in ceramic gas turbine shrouds and ceramic combustors, and test techniques to understand the effects of inlet temperature distortion on engine operation, among others, had their genesis under VPD/NASA-Lewis. Under ARL’s banner, the same pressures that were exerted on aviation propulsion technologies will now be extended to ground vehicles.
VEHICLE PROPULSION DIRECTORATE

FACILITIES USED IN ARMY PROGRAMS (OWNED BY HOST: NASA-LEWIS)
SOME SPECIAL EQUIPMENT AND FULL-SIZE
HARDWARE FURNISHED BY THE ARMY

FACILITIES

<table>
<thead>
<tr>
<th>SYSTEM LEVEL/MAJOR ITEMS</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3000-5000 HP TRANSMISSION STAND</td>
<td>UH-60 &amp; AH-64 SIZE</td>
</tr>
<tr>
<td>300-500 HP TRANSMISSION STAND</td>
<td>OH-58/AMPH SIZE</td>
</tr>
<tr>
<td>ENGINE COMPONENTS RESEARCH LAB</td>
<td>T55, T700, T800 SMALL TURBOSHAFT ENGINE</td>
</tr>
<tr>
<td>PROPULSION SYSTEMS LABORATORY (*)</td>
<td>RESEARCH (STER) TEST BED</td>
</tr>
<tr>
<td>ICING RESEARCH TUNNEL (*)</td>
<td>ALTITUDE AND DISTORTION TESTING IN SUPPORT OF</td>
</tr>
<tr>
<td>1 x 1 SUPersonic TUNNEL</td>
<td>LH PE0/T800 QUALIFICATION</td>
</tr>
<tr>
<td>Rotorcraft Systems (Blades, Weapons, Inlets)</td>
<td></td>
</tr>
<tr>
<td>Special test for Picatinny (Artillery Round)</td>
<td></td>
</tr>
</tbody>
</table>

COMPONENT LEVEL

| COMPRESSION RESEARCH | 3 RIGS (AXIAL, CENTRIFUGAL, AND MULTISTAGE) |
| TURBINE RESEARCH | 2 RIGS (AXIAL, RADIAL) |
| COMBUSTOR RESEARCH | 4 RIGS (BASIC COMBUSTION SCIENCES AND SMALL COMBUSTORS) |
| LUBRICATION/ TRIBOLOGY RESEARCH | 12 RIGS (SURFACE SCIENCE, FRICTION, LUBRICATION, WEAR) |
| MECHANICAL COMPONENT RESEARCH | 9 RIGS (GEARS); 5 RIGS (BEARINGS); 1 RIG (SEALS); 2 RIGS (CLUTCHES) |

COMPUTATIONAL SCIENCES

| FLUID MECHANICS/FLUID DYNAMICS | 1 COMPRESSIBLE FLOW RIG; 1 TRANSONIC CASCADE RIG |
| DATA PROCESSING | MAINFRAMES......2 CRAY (XMP & YMP); ALLIANT PARALLEL |
| | PROCESSOR; 2 AMDAHL; 2 IBM (3070 & 3090); 2 VAX |
| | CLUSTERS; TRANSIENT DATA ACQUISITION AND RECORDING |

(*) CATEGORIZED AS NATIONAL FACILITY

All of the facilities used to conduct the Vehicle Propulsion Directorate program are owned by the NASA Lewis Research Center, our host. The facility assets run the full range of complexity from simple gear material fatigue rigs, requiring little operator interaction once the test specimen is installed, to complete engine system altitude chambers, requiring over a dozen operators. The facilities cover the full spectrum of experimental requirements for airbreathing engines and power transfer systems. State-of-the-art data acquisition and reduction capabilities are provided in most of the facilities along with all necessary test support hardware. Several recognized national facilities are included in this inventory.
The objective of the Large, Low-Speed Compressor research project is to obtain detailed measurements to: (1) improve our fundamental understanding of the unsteady flow physics which characterize blade row interactions in multistage compressors; and (2) aid in the development of closure models required for the Averaged-Passage approach to predicting multistage compressor flow fields. The LSAC is a four foot diameter, four-stage axial compressor with inlet guide vanes, and is patterned after the General Electric Low Speed Research Compressor. Both use a four-stage design and concentrate research in the third stage. The first two stages, preceded by a long inlet duct, build up thick endwall boundary layers and a representative multistage flow field, while the fourth stage buffers the third stage from the downstream diffuser and collector flow field. The LSAC became operational in June, 1992 and initial measurements were obtained. The results indicated the need for slight restaggering of the inlet guide vanes and the first stage rotor to achieve repeatable stage performance characteristics.
The 2-stage, 5:1 axial compressor program is a cooperative effort involving the U.S. Army Vehicle Propulsion Directorate, NASA Lewis, and the Allison Gas Turbine Division of General Motors. Multistage CFD analyses of two preliminary designs were conducted at Lewis under Army support, and recommended changes, based on the analytical results, were incorporated in the final detailed design. This compressor is expected to demonstrate the highest pressure ratio yet achieved (5:1) using only two axial stages, while maintaining efficiency and surge margin. Compressor hardware has been fabricated and delivered to Lewis Research Center for testing in the Small Compressor Test Facility. Facility modifications and instrumentation preparations are nearing completion. Testing is scheduled to commence during the second quarter of FY93.
The Lycoming T55-L-712 turboshaft engine has experienced an intermittent stall problem since its entry into service. The VPD has initiated a detailed analytical/experimental program to define the nature of this stall problem and to explore corrective measures to prevent its occurrence in future engines. A dynamic compressor model has given preliminary indications that the problem exists in the first stage rotor. A grant continues with Virginia Polytechnical Institute for the development of an advanced post-stall modeling code. A joint three year effort has begun with AEDC (Arnold Engineering Development Center) to develop an advanced dynamic/transient engine model. Facility modifications for a 1993 in-house engine test, to be conducted as part of the Small Turboshaft Engine Research (STER) activity, have begun. Instrumentation of the test rig and the engine has also been started. A joint NASA/Army effort is underway to explore an advanced compressor stability enhancement concept for the T55-L-712 compressor. NASA will be involved in the controls development and MIT (Massachusetts Institute of Technology) will provide an appropriate compressor model.
The objective of the IHPTET (Integrated High Performance Turbine Engine Technology) program is to greatly increase the performance, while simultaneously reducing the weight of conventional gas turbine engines. Magnetic bearings offer the opportunity to eliminate the lubrication system and oil seals, extend bearing life and DN (size*speed parameter), allow for adaptive vibration control, in addition to compatibility with the goal for all-electric engine accessories. The NASA Lewis Research Center and the Vehicle Propulsion Directorate have started a joint, high temperature magnetic bearings program, which will be investigating high temperature probes, compact wire insulation, and fiber reinforced laminates. High temperature materials and insulation testing has been started, as well as 3D magnetic bearing modeling. In addition, an in-house active control stability code has been used to predict the stability limits of the magnetic bearing rig. A cooperative program has been started between NASA/Army, Allison Gas Turbine Division, the University of Virginia, and Texas A&M University. It is a focused effort to build and test a 1000°F-1200°F magnetic thrust bearing.
OBJECTIVE/PROBLEM STATEMENT:
- Conduct experimental component testing to understand and quantify improvements and validate analytical predictions.

DELIVERABLES:
- Improved understanding of operational and design parameters on component life, reliability, and noise.
- Experimental validation of advanced designs.

ACCOMPLISHMENTS:
- FY 91: Completed preliminary spiral bevel gear lubrication experiments.
- FY 92: Completed spur gear pitting fatigue testing with two synthetic lubricants.
  - Initial face gear evaluation complete.

PLANS:
- FY 93: Complete face gear evaluation.
- FY 94: Complete spiral bevel gear lube studies.
  - Complete MSONIL gear material tests.
  - Complete joint Army/NASA/Navy lube tests.

A recent evaluation in the drive system components area investigated the feasibility of using face gears in a high-speed and high power environment such as found in rotorcraft transmissions. Helicopter transmissions are usually required to redirect the engine power output from the horizontal direction to the vertical in order to power the main rotor. This turning has traditionally been accomplished with spiral bevel gears. The use of face gears in this application (in a torque sharing arrangement) has been projected to reduce the main rotor transmission weight by up to 25 percent. Face gears, however, have previously been used only at low speeds and torques. In this effort, four half-scale face gear sets were tested in a closed-loop test stand at pinion rotational speeds to 19,100 rpm and to 271 kW (364 hp). All four sets of gears successfully ran at 100 percent of design torque and speed for 30 million pinion cycles, and two sets successfully ran at 200 percent of torque for an additional 30 million cycles. These results were a positive indication of the potential for using face gears in helicopter transmissions.
OBJECTIVE/PROBLEM STATEMENT:
- Increased power/weight ratio and lower SFC can be achieved only through higher pressure ratios and higher turbine inlet temperatures with fewer and lighter components.
- Explore a technology that has the potential to meet these requirements and contribute to the IHTET goals.

DELIVERABLES:
- One stage of compression and expansion in a single, light weight device.
- Higher combustor temperatures and higher “effective” turbine inlet temperatures without the need for exotic turbine materials.
- Potential reductions in loss caused by small size of final stage in multistage compression systems.
- CFD analysis capability for wave rotor applications.
- Unbleed determination of optimum engine cycles for wave rotor applications.

PROGRAM SCHEDULE

<table>
<thead>
<tr>
<th>TASKS</th>
<th>FY 92</th>
<th>FY 93</th>
<th>FY 94</th>
<th>FY 95</th>
<th>FY 96</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grant with Cornell University</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Code Development</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Build Wave Rotor Test Rig</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine Cycle Analysis With Wave Rotor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wave Rotor Experiment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ACCOMPLISHMENTS:
- FY 91: Continued grant activity with Cornell University.
- FY 92: Two computer codes were completed to calculate wave rotor performance.
- FY 93: Preliminary engine cycle studies were begun.
- FY 94: Fabricated wave rotor test package.
- FY 95: Build up of the test facility was completed.

PLANS:
- FY 93: Computer code development will continue.
- FY 94: Begin wave rotor experiment.
- FY 95: A cycle study of an existing engine with a wave rotor topping cycle will be completed.

A joint NASA Lewis/Vehicle Propulsion Directorate program is underway to examine the wave rotor as a potential topping cycle for gas turbine engines, which would allow them to operate more efficiently at significantly higher pressures and temperatures. A wave rotor consists of many tubes placed around the outside of a rotating drum. The flow in each tube alternates between combustor gas and fresh air from a conventional compressor. When combustor gas enters the tube, it drives a shockwave through the fresh air, causing additional compression. The charge of highly compressed fresh air is then delivered to the combustor. The combustor gas still in the tube is exhausted by an expansion wave which forms to balance the energy that was used in compression. The expansion wave cools the combustion gas, so that it can be allowed to flow out through a conventional turbine. Because each tube is intermittently cooled by fresh air, very high combustion temperatures can be achieved without the use of complex cooling schemes. By replacing the high spool(s) of a gas turbine engine with a wave rotor, significant performance improvements could be achieved. Computer codes have been developed to predict the wave motion and performance of wave rotors. An experimental facility has been designed and constructed to verify code predictions. Initial results show very good agreement between experiment and prediction.
The Vehicle Propulsion Directorate is a relatively small organization. Thus, its budget is also small in comparison to other ARL directorates. The FY93 budget, after accounting for costs of opening our doors (e.g., salaries, travel, training, assessments,...) leaves approximately $1.5M program funding. There is essentially no growth projected through FY99. Under ARL, our charter has been enlarged from its original aviation emphasis to include ground vehicle basic research. The funding projection related to ground vehicle propulsion basic research is constant. It has also been projected that staffing at the VPD will increase slightly, to deal with the new ground vehicle propulsion role. There is not sufficient funding to permit increasing the staff while also maintaining a vibrant, technology pushing program.
Cooperative Research and Development Program with Industry

- **SHARING OF EACH OTHER'S CAPABILITIES, IDEAS, AND RESOURCES TO ACHIEVE COMMON OBJECTIVES**

- **NO FUNDS EXCHANGE HANDS**

- **BENEFITS TO THE ARMY PROPULSION COMMUNITY**
  - LEVERAGES NASA AND INDUSTRY RESOURCES
  - MINIMIZES ARMY COST FOR TECHNOLOGY DEVELOPMENT
  - PERMITS US TO DO TOGETHER, WHAT OTHERWISE COULD NOT BE DONE ALONE

**CONDUCTED UNDER NON-REIMBURSABLE SPACE ACT AGREEMENT**

Being used with increasing frequency in the present financial atmosphere

The Vehicle Propulsion Directorate has been entering into an increasing number of cooperative research and development programs with industry in the past few years. These programs are conducted under non-reimbursable space act agreements, wherein the parties share with each other their capabilities, ideas, and resources to achieve common objectives. No funds are exchanged. Rather, the parties contribute to the common task what they can best bring to the program. Generally, the Army's contribution is an analytical effort or test activity in one of our unique facilities. Industry's contribution is generally in the form of design and manufacture of hardware. In this way, the Army, NASA Lewis and industry leverage each other and minimize the cost to any one party for technology development. We accomplish together what none of us could accomplish alone.
PROPOSED SBIR TOPICS FOR FY93

- Advanced High Temperature Strain Isolator Material System
- Depleted Oxygen Gas Turbine Combustor Design
- Brush Seal Shaft Wear Resistant Coating
- Electromotive Propulsion Concepts for Rotorcraft
- Fast Acting Valves for Turbomachinery Bleed Applications

POC for SBIR activities: Mr. Pete Meitner, 216-433-3715

Another medium for pursuing tech base programs is through Small Business and Innovative Research programs. The topics proposed by the Vehicle Propulsion Directorate for solicitation in FY93, which have a reasonable chance for being solicited, are listed in the figure.
VEHICLE PROPULSION DIRECTORATE

SUMMARY

• VPD CONDUCTS A TECH BASE PROGRAM THAT IS DRIVEN BY THE NEEDS OF THE SOLDIER

• PROGRAM CONDUCTED USING WORLD CLASS RESOURCES, (SPECIALISTS AND FACILITIES) FOR ALL ENGINE AND TRANSMISSION TECHNOLOGIES

• VPD HAS ESTABLISHED A CENTER OF EXPERTISE FOR VEHICLE PROPULSION THAT IS SOUGHT BY OTHERS (CONSULTATION, COOPERATION, ....)

• VPD WILL CONTINUE TO CONDUCT A VIBRANT PROGRAM WITH AVAILABLE RESOURCES USING ANY VEHICLE AT OUR DISPOSAL
Battlefield Environment Directorate

Mission

- Develop battlefield atmospheric modeling and simulation capabilities to represent battlefield atmospheric conditions.
- Investigate aerosol physics properties related to the propagation of electromagnetic energy through battlefield atmospheres contaminated by natural and combat induced obscurants.
- Research and develop atmospheric characterization techniques and instrumentation, assess the susceptibility of Army materiel and operations to atmospheric conditions, and support such assessments as required.
- Research, develop, and exploit atmospheric sensing technology to collect battlefield weather data, including remote detection of various aerosol and gaseous components in the atmosphere.
- Develop battle weather data processing techniques for quantifying the meteorology over the battle area.
- Create methods and techniques to mitigate effects of battlefield atmospheres on friendly materiel and operations and exploit the knowledge of atmospheric effects on threat systems.
PERSONNEL BY CATEGORY AND DEGREE

TOTAL ASSIGNED: 148
S&E's ASSIGNED: 99

OVERALL FUNDING STATUS ($K)

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>FY92</th>
<th>FY93</th>
<th>FY94</th>
<th>FY95</th>
<th>FY96</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASIC RESEARCH (6.1)</td>
<td>531k</td>
<td>5854</td>
<td>6153</td>
<td>6431</td>
<td>6469</td>
</tr>
<tr>
<td>EXPLORATORY DEVELOPMENT (6.2)</td>
<td>4953</td>
<td>5895</td>
<td>6396</td>
<td>7074</td>
<td>7046</td>
</tr>
<tr>
<td>MET EFFECTS ASSESSMENT (6.5)</td>
<td>9936</td>
<td>9552</td>
<td>9922</td>
<td>9578</td>
<td>8863</td>
</tr>
<tr>
<td>SMALL BUSINESS INNOVATION RSCH (6.5)</td>
<td>1045</td>
<td>1065</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>OTHER</td>
<td>398</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>SUBTOTAL</td>
<td>21553</td>
<td>22168+</td>
<td>22471+</td>
<td>23083+</td>
<td>22178+</td>
</tr>
<tr>
<td>CUSTOMER</td>
<td>6740</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>TOTAL</td>
<td>28293</td>
<td>22168+</td>
<td>22471+</td>
<td>23083+</td>
<td>22178+</td>
</tr>
</tbody>
</table>

Subject to change based upon DoD and Congressional action
FY92 FUNDING PROFILE
IN-HOUSE VS CONTRACTS

In-House
$15023 53%

Contracts
$13270 47%

TOTAL: $28,293 K

ACTIVE CONTRACTS
FY 92

$25K to $100K
47%

$100K to $500K
29%

$500K to $1M
22%

Greater than $1M
2%
FY94
- Weather/Obscuration Effects in Wargames
  -- 4D Weather & Obscuration
- Transport & Diffusion
- Optical Simulator for Real Time Turbulence Effects

FY95
- Battlefield Obscuration Modeling
  -- Exotic Battlefield Aerosols
  -- Artificial Fogs
- Enhanced Physical Basis for Optical Turbulence Simulator

FY96
- Miniaturized Real Time Optical Turbulence Simulator for General Army Applications

POC: Dr. D. Brown
Phone 505-678-2412, Fax 505-678-2053
AMSRL-BE-S, White Sands Missile Range, NM 88002-5501

ATMOSPHERIC ASSESSMENT
FUTURE EFFORTS

- FY94
  - Upper Atmospheric Models for Theater Missile Defense
  - Millimeter Wave Imager Capability
  - Electro-Optical Systems Performance Models
- FY95
  - Mobile Spectroscopy Facility
  - Characterization of Tailored Broad Band Screeners
- FY96
  - Validation and Verification of EOSAEL models
  - Obscurant Characterization by LIDAR
  - Smoke Cloud Tomography
- Continuing Support to Atmospheric Characterization
  (Smokes, Obscurants, etc.)

POC: Mr. D. R. Veezey
Phone 505-678-3331, Fax 505-678-7919
AMSRL-BE-A, White Sands Missile Range, NM 88002-5501
BATTLE WEATHER DATA
AQUISITION & PROCESSING
FUTURE EFFORTS

- FY94
  - UltraViolet Chem-Bio Warfare Detection Techniques
  - SATCOM Weather Broadcasting Tech Demonstration
  - Mobile Profiler Technology Demonstration
  - Technology for Deriving Atmospheric Profiles from Multi-frequency Sensors
  - Computer Assisted Artillery Meteorology for Tech Demonstration

- FY95
  - Improved Data Acquisition/Distribution/Forecaster Aid Software
  - 12-Hr Target Area Meteorology Forecasting Capability

- FY96
  - Prototype Horizontal Path Adaptive Optics Technology
  - Non-hydrostatic Battle Scale Forecast Model on Army Tactical Command & Control System (ATCCS) Common Hardware/Software

POC: Dr. M. A. Seagraves
Phone 505-678-1339, Fax 505-678-3385
AMSRL-BE-W, White Sands Missile Range, NM 88002-5501

ATMOSPHERIC MITIGATION & EXPLOITATION
FUTURE EFFORTS

- FY94
  - Two Stream Acoustic Propagation Model
  - Characterization Techniques for Weather Effects on Camouflage

- FY95
  - Advanced Electro-Optical Target Acquisition Model
  - Aerial Intelligence Preparation of the Battlefield Automation
  - Weather Decision Aids on Portable Weather Workstation

- FY96
  - 3-D Two-way Acoustic Propagation Model
  - Real-time Obscurant Scene Visualization

POC: Dr. F. E. Niles
Phone 505-678-3721, Fax 505-678-8366
AMSRL-BE-M, White Sands Missile Range, NM 88002-5501
Potential CRDA Areas
- Atmospheric Numerical Modeling
- Atmospheric Remote Sensing

Some Recent SBIR Efforts
- Portable FM-CW Doppler Radar to Provide Meteorological Data
- Water and Temperature Profiles in the Turbulent Surface Layer
- Acoustic Scattering by a Vortex Model of Turbulence
- Saltation & Suspension of Sediment by Turbulent Wind
- Atmospheric Boundary Layer Stability Estimator for Urban Areas
- Four Dimensional Mesoscale Non-Gaussian Multispectral Smoke Model
ARL APBI

NAVAL SURFACE WARFARE CENTER
WHITE OAK, MARYLAND

PRESENTED BY:

DR. C.G. THORNTON
DIRECTORATE EXECUTIVE
ELECTRONICS and POWER SOURCES DIRECTORATE
U.S ARMY RESEARCH LABORATORY
FORT MONMOUTH, NEW JERSEY

28 JANUARY 1993

ELECTRONICS and POWER SOURCES
BUSINESS AREAS

MICROWAVE/MILLIMETER/MIMIC DEVICES
ACOUSTO/FERROELECTRONICS
NANO/OPTOELECTRONIC/PHOTONIC DEVICES
OPTICAL MATERIALS/DEVICES AND FOCAL PLANE ARRAYS
ADVANCED SENSOR/ACTUATOR DEVICES
DESIGN/SIMULATION, MODELING, CONCURRENT ENGINEERING, AND PROTOTYPING
RELIABILITY AND MANUFACTURING SCIENCE
POWER SOURCES (INCLUDING PULSE POWER)
VIRTUAL ENVIRONMENT (DISPLAY) DEVICES
EPS Directorate
FY 93 Acquisition Plan
(Estimated obligations in millions)

76% INCREMENTAL FUNDING MODIFICATIONS
70% CUSTOMER FUNDED
(DARPA, ETC.)

$200
$150
$100
$50
$0

OBLIGATIONS

173

73

200
150
100
50
0

ACTIONS
ELECTRONICS AND POWER SOURCES
FUTURE DIRECTIONS

<table>
<thead>
<tr>
<th>PAST</th>
<th>PRESENT</th>
<th>FUTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICROELECTRONICS</td>
<td>MICRO/QUANTUM ELECTRONICS</td>
<td>NANOELECTRONICS (Quantum Transport, Atomic Transitions, Mesoscopic, 3D, Multi-Material, Manufacturing Science)</td>
</tr>
<tr>
<td>MICROWAVE/MILLIMETER-WAVE DEVICES, IR ARRAY TECHNOLOGY, MMIC DEVICES</td>
<td>INTEGRATED MW/MMW/PHOTONIC (Millimeter Focal Plane, Smart/Adaptive)</td>
<td></td>
</tr>
<tr>
<td>DISPLAYS</td>
<td>INFORMATION INTERFACE</td>
<td>VIRTUAL ENVIRONMENT DEVICES (Micro, High Definition, Retinal, Large Screens)</td>
</tr>
<tr>
<td>POWER SOURCES</td>
<td>POWER SOURCES</td>
<td>ALTERNATIVE ENERGY SOURCES (Mini-Fuel Cells, Micro-Generators, SMEPS, Hi-Density Energy Storage)</td>
</tr>
<tr>
<td>PULSE POWER</td>
<td>OPTOELECTRONICS, OPTICAL MATERIALS, FOCAL PLANE ARRAYS</td>
<td>INTEGRATED MICROPHOTONIC DEVICES (OICs, Optical Devices/ Bench-on-a-Chip, Smart Picocells)</td>
</tr>
<tr>
<td>PHOTONICS</td>
<td>ACOUSTOELECTRONICS</td>
<td>MICROSENSOR/ACTUATOR/CONTROL DEVICES (Micro electromechanical, biomechanical, Ferroelectric and Magnetic, Ferroconductor)</td>
</tr>
<tr>
<td>FREQUENCY CONTROL/ACOUSTICS</td>
<td>MAGNETICS</td>
<td></td>
</tr>
<tr>
<td>SUPERCONDUCTORS</td>
<td>FERROELECTRONICS</td>
<td></td>
</tr>
<tr>
<td>BIO SENSORS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ELECTRONICS and POWER SOURCES
FY93 PROGRAM

1 JANUARY 1993
* MIMIC PHASE II
* MICROWAVE ANALOG FRONT-END TECHNOLOGY (MAFET)
* RAPID PROTOTYPING OF APPLICATION SPECIFIC SIGNAL PROCESSORS (RASSP)
* MICROWAVE HARDWARE DESCRIPTION LANGUAGE (MHDL)
* APPLICATION-SPECIFIC ELECTRONIC MODULES (ASEM)
HIGH LEVERAGE PIVOTAL TECHNOLOGY

MICROWAVE/MILLIMETER/MIMIC DEVICES
- INTEGRATED PHOTONIC-MMIC's
- QUASI-OPTICAL MILLIMETER WAVE ELECTRONICS
- MICROWAVE/MILLIMETER WAVE IMAGING TECHNOLOGY
- PHYSICS BASED MODELLING OF MW + PHOTONIC DEVICES
- MICROWAVE HARDWARE DESCRIPTION LANGUAGE (MHDL)
- MICROWAVE/MILLIMETER WAVE RELIABILITY

ACOUSTO/FERROELECTRONICS
- SURFACE ACOUSTIC WAVE DEVICES
- FERROELECTRONIC DEVICES
- LOW-NOISE/VIBRATION-IMMUNE CRYSTAL OSCILLATORS
- MICROSENSORS

DESIGN/SIMULATION, MODELING, CONCURRENT ENGINEERING AND PROTOTYPING
- ELECTRONIC MODULES & COMPONENTS
- DEVICES AND PROCESSING
- PACKAGING

DEVICE RESEARCH
- NANO/OPTOELECTRONIC/PHOTONIC DEVICES
- OPTICAL MATERIALS/DEVICES AND FOCAL PLANE ARRAYS
- ADVANCED SENSOR/ACTUATOR DEVICES
- INFRARED DETECTOR TECHNOLOGY
- HIGH TEMPERATURE SUPERCONDUCTING DEVICES
- PERMANENT MAGNET DESIGN

RELIABILITY AND MANUFACTURING SCIENCE

POWER SOURCES (INCLUDING PULSE POWER)
- HIGH-RATE, HIGH-ENERGY, ENVIRONMENTALLY-BENIGN THROWAWAY BATTERIES
- HIGH-ENERGY RECHARGEABLE (MULTICAPABLE) BATTERIES
- ADVANCED ENERGY STORAGE CONCEPTS
- HIGH-ENERGY, HIGH-REP RATE CAPACITORS
- HIGH-REP RATE, HIGH-ENERGY PULSER SWITCHES
- HIGH-ENERGY PULSER COMPONENTS
VIRTUAL ENVIRONMENT (DISPLAY) DEVICES

- Electronic Modules and High Resolution Display Components
- Hi-Resolution Multicolor Displays

MIMIC PROGRAM STATUS
(January 1993)

- Phase 1 - 93 Unique Chips for 20 Military Systems Designed
  and 60% RF Functional on First Iteration
- Phase 2 - 76 Complex Chips for More than 20 Primary
  Applications Are Being Developed
- Advanced Power Processes (HBT, HFET and PHMPT) Are Introduced
  For High Performance (More than 10% Efficiency Improvement,
  1W Power at Ka Band and 100 mW at W Band
- HBT Technology Utilized For Low Phase Noise VCO Applications
- Major Improvement in First Pass Design Has Been Demonstrated
  During Phase 2 By Using CAD Tools (Design Centering, EM
  Simulation, Etc.) and Improved Models
- Distributed Relational Data Supports Design, Processing and
  Testing For Improved Productivity
- Major Improvement in On-Wafer Testing (From 5 hours, To 6 minutes
  Extended to On Wafer Temperature Testing, Automated Pulsed
  RF Power Testing and To Higher Frequencies At W Band)
- Cost of Qualified Chips Reduced From $500 to $8 Per MM Square
- More Than 100 Chip Types Developed Under the MIMIC Program
  Offered for Sale
MICROWAVE/MILLIMETER WAVE

TECHNOLOGY AREAS OF INTEREST

- INTEGRATED PHOTONIC - MMIC's
- QUASI-OPTICAL MILLIMETER WAVE ELECTRONICS
- MICROWAVE/MILLIMETER WAVE IMAGING TECHNOLOGY
- PHYSICS BASED MODELLING OF MW + PHOTONIC DEVICES
- MICROWAVE HARDWARE DESCRIPTION LANGUAGE (MHDL)
- MICROWAVE/MILLIMETER WAVE RELIABILITY

OBJECTIVES:

- MEET PERFORMANCE REQUIREMENTS OF MW/MMW ELECTRONICS FOR MISSILE GUIDANCE, RADAR, JAMMERS, AND SENSORS.

- DEVELOP OPTICAL/MMW ICs FOR DISTRIBUTION OF CONTROL SIGNALS FOR NEXT GENERATION ACTIVE PHASED-ARRAY RADAR AND COMMUNICATIONS.

- DEVELOP MODELING AND SIMULATION TECHNIQUES FOR MW/MMW DEVICES AND PROCESSES.
DESIGN/SIMULATION, MODELING, CONCURRENT ENGINEERING

TECHNOLOGY AREAS OF INTEREST

- ELECTRONIC MODULES & COMPONENTS
  - RAPID PROTOTYPING OF APPLICATION-SPECIFIC SIGNAL PROCESSORS (RASSP)
  - APPLICATION-SPECIFIC ELECTRONIC MODULES (ASEM)
  - DIRECT DIGITAL SYNTHESIZERS
  - NEURAL NETWORKS
- DEVICES AND PROCESSING
  - SILICON TECHNOLOGY
  - III-V DEVICES
- PACKAGING
  - 3-DIMENSIONAL PACKAGING
  - HIGH-POWER-MICROWAVE-IMMUNE PACKAGING

OBJECTIVE:

- MAINTAIN DoD S&T LEAD IN APPLICATION OF THE NEXT MAJOR ADVANCES IN MICROELECTRONICS, REDUCING SIZE & WEIGHT BY A FACTOR OF 20 WHILE INCREASING THROUGHPUT TO MULTI-GIGAFLOP LEVELS. IMPLEMENT THE ARMY PORTION OF THE RASSP AND ASEM PROGRAMS.

- ACHIEVE FAILURE-FREE MICROELECTRONICS.

DESIGN/SIMULATION, MODELING, CONCURRENT ENGINEERING

ELECTRONICS and POWER SOURCES

RAPID PROTOTYPING OF APPLICATION SPECIFIC SIGNAL PROCESSORS (RASSP)
VIRTUAL ENVIRONMENT
(DISPLAY) DEVICES

TECHNOLOGY AREAS OF INTEREST

- ELECTRONIC MODULES AND HIGH RESOLUTION DISPLAY COMPONENTS
- HI-RESOLUTION MULTICOLOR DISPLAYS

OBJECTIVE:

- PROVIDE SOLDIER/DISPLAY INTERACTIVE INTERFACES TO SERVE AS A FORCE MULTIPLIER IN INFORMATION INTENSIVE BATTLEFIELD APPLICATIONS.
- DEVELOP PROTOTYPE, HIGH-RESOLUTION, RUGGED, LOW POWER, DISPLAY PANELS IN SIZES RANGING FROM MINIATURE PERSONAL VIEWERS TO LARGE SCREEN DISPLAYS.
- DEVELOP, DEMONSTRATE, AND EVALUATE PROTOTYPE MULTICOLOR, HIGH RESOLUTION FLAT PANEL INTERACTIVE DISPLAYS FOR MAN PORTABLE, VEHICLE, AIRCRAFT AND GROUND APPLICATIONS.

PRINCIPAL USERS:

- CENTERS/LABS: CECOM, MICOM, TACOM, CACDA, HEL, NAVY, AIR FORCE, MARINES
- PMs: AMMOLOG, TMDE, OPTADS, AFATDS
ACOUSTO/FERROELECTRONICS

TECHNOLOGY AREAS OF INTEREST

- SURFACE ACOUSTIC WAVE DEVICES
  - SIGNAL PROCESSORS
  - LOW-NOISE OSCILLATORS
  - CHANNELIZERS
- FERROELECTRONIC DEVICES
  - SENSORS
- LOW-NOISE/VIBRATION- IMMUNE CRYSTAL OSCILLATORS
  - QUARTZ CRYSTAL RESONATORS
  - NEW PIEZOELECTRIC DEVICES/RESONATORS
- MICROSENSORS

OBJECTIVE:

- DEVELOP ULTRA-STABLE, LOW NOISE FREQUENCY SOURCES AND CLOCKS FOR IFF, RADAR AND COMMUNICATIONS.
- PROVIDE ACOUSTIC-WAVE ANALOG SIGNAL PROCESSING DEVICES FOR REAL-TIME MULTIPLE EMITTER AND PASSIVE TARGET DETECTION IN HIGH DENSITY/HIGH-CLUTTER SIGNAL ENVIRONMENTS.

LOW NOISE EXCITER FOR TPO-36 TRANSMITTER
- EXCELLENT CLUTTER SUPPRESSION
- REDUCED PROBABILITY OF FALSE ALARMS
- ENHANCED TARGET DETECTION

SAW BANDPASS FILTER FOR ELINT CHANNELIZER
- LOW LOSS, LOW COST
- HIGH SPURIOUS REJECTION
- MONOLITHIC

PHASE II OF MCXO GIVING 2 MILLSCEOND PER DAY ACCURACY

DRO/FET TRANSMITTER SOURCE FOR SDF BEACON
- HIGH FREQUENCY STABILITY
- INSTANT TURNO ON
- SMALL SIZE/WEIGHT/POWER CONSUMPTION
POWER SOURCES
(INCLUDING PULSE POWER)

TECHNOLOGY AREAS OF INTEREST

- HIGH-RATE, HIGH-ENERGY, ENVIRONMENTALLY-BENIGN THROWAWAY BATTERIES
- HIGH-ENERGY RECHARGEABLE (MULTICAPABLE) BATTERIES
- ADVANCED ENERGY STORAGE CONCEPTS
- HIGH-ENERGY, HIGH-REP RATE CAPACITORS
- HIGH-REP RATE, HIGH-ENERGY PULSER SWITCHES
- HIGH-ENERGY PULSER COMPONENTS

OBJECTIVE:

- PROVIDE PORTABLE POWER FOR THE FULL RANGE OF ARMY EQUIPMENT.
- IMPROVE PULSE POWER CONDITIONING COMPONENTS AND TECHNIQUES FOR DIRECTED ENERGY/KINETIC ENERGY WEAPONS, AND ELECTRIC DRIVES/ACTUATORS FOR COMBAT VEHICLES.

PROPOSED POWER SOURCES BAA

US ARMY RESEARCH LABORATORY

- LOW COST RECHARGEABLE PRIMARY BATTERY FOR GENERAL MILITARY APPLICATION
- RECHARGEABLE LITHIUM-LIKE BATTERIES (RLLB)
- IMPROVED MAGNESIUM BATTERIES
- PRIMARY BATTERY FOR SOLDIER SYSTEM, MAXIMUM ENERGY DENSITY
- PRIMARY BATTERY FOR SOLDIER SYSTEM, MAXIMUM POWER DENSITY
ELECTRONIC DEVICE RESEARCH

TECHNOLOGY AREAS OF INTEREST

- NANO/OPTO/PHOTOELECTRONIC DEVICES
- OPTICAL MATERIAL/DEVICES AND FOCAL PLANE ARRAYS
- ADVANCED SENSORS AND ACTUATORS (MEMS)
- INFRARED DETECTOR TECHNOLOGY
- HIGH TEMPERATURE SUPERCONDUCTING DEVICES
- PERMANENT MAGNET DESIGN

OBJECTIVE:

- DEVELOP THE MATERIAL AND DEVICE TECHNOLOGY FOR NANO SCALE ELECTRONIC AND OPTOELECTRONIC DEVICES REQUIRED FOR HIGH FREQUENCY MICROELECTRONICS, RADAR AND OPTICAL SIGNAL PROCESSING. CREATE BOTH COOLED AND UNCOOLED INFRARED TECHNOLOGY FOR LOW-COST LARGE MULTI-COLOR INFRARED STARING ARRAYS. PROVIDE HIGH TEMPERATURE SUPERCONDUCTING DEVICES FOR RADAR RECEIVERS.
**ELECTRONIC DEVICE RESEARCH**

- **MULTIMODE SMART SENSOR**
  - MM Wave
  - Imaging MMic
  - Radar inputs
  - Detection Plane
  - Signal Fusion
  - "Smart" Neural Net Processor
  - Smart Sensor Output

- **MONOLITHICALLY INTEGRATED DETECTOR PROCESSOR STRUCTURE**
  - Metal Contact
  - Passivation

- **SPATIAL LIGHT MODULATOR USING SMART PIXEL INTERCONNECTION**
  - Smart Pixel Array for Reconfigurable Interconnect
  - Each Pixel Has Optical In/Output Plus Drive and Decode Electronics

---

**EPSD SPONSORED CONSORTIA/COOPERATIVES**

**SUBJECT**

- LOG R&D - COST REDUCTION
- METEOROLOGICAL DATA SYSTEM
- SYSTEM DESIGN METHODOLOGY
- TEL COLOR DISPLAY
- ULTRAPURE QUARTZ CRYSTAL
- PRECISION OSCILLATOR
- QUARTZ STUDIES
- MLRS MM WAVE TRANSCEIVER
- DUAL MODE SEEKER
- SADARM MM WAVE TRANSCEIVER
- MM WAVE ANTENNAS
- MM WAVE IMAGING RADARS
- SATCOM-SCOTT TRANSMITTER
- NOISE SOURCE FOR 94 GHZ
- TANK DEFENSE RADAR
- PARTS EMULATION
- HIGH PERFORMANCE DAC
- VEHICLE SELF-PROTECTION
- **MIMIC HDL**

**MEMBERS**

- AT&T, TRW, RTI, INTERMETRICS, IBM, HONEYWELL, GOULD
- TRW, SAWTEK, TRACOR, BENDIX, VIZ
- RTI, TELEDYNE BROWN, UVA, GTE, CSC, JERSEY CITY STATE COLLEGE
- PLANAR, SARTOF, SUPERTEX, NORDEN, ELDEC
- OK STATE U. LAWRENCE LIVERMORE LABORATORY, SAWYER RESEARCH
- GE NEUTRON DEVICES, PIEZO TECH., INC.
- PRINCETON U. RENSSLEAER, MCI, RAYTHEON
- TRW, HUGHES, (MARTIN MARIETTA, DIEHL, THOMPSON CSF, THORN)
- CHANG INDUSTRIES, NORTHROP, MICOM RDEC
- HONEYWELL, VARIAN, HUGHES, AEROJET, ALPHA, BALL AEROSPACE, TRW, FLAM & RUSSELL
- WTD, MICOM RDEC
- STEINBRECHER, M-A-COM, HUGHES, FLAM & RUSSELL, GE E-LAB
- NOISE COM, M-A-COM
- TACOM, TRW, TI, BALL, MILLITECH, MICOM, BRL, HUGHES, GEORGIA TECH, PREDICTION SYSTEMS, CHANG INDUSTRIES
- ITD, SYNOPSYS, QUIKTURN, SIGNETICS, GD
- RAOC
- WTD, MICOM RDEC, ARMAMENTS RDEC
- ESSOF, INTERMETRICS, PERAI
### EPS LABORATORY IMPLEMENTATION OF THE TECHNOLOGY TRANSFER ACT OF 1986

**COORDINATE R&D AGREEMENTS (CRDAs) IN EFFECT**

#### ELECTRONICS and POWER SOURCES

<table>
<thead>
<tr>
<th>PARTICIPANTS</th>
<th>AREA OF TECHNOLOGY TRANSFER</th>
<th>FOTE/SUB-FOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSD - ELECTROMAGNETIC SCIENCES</td>
<td>HIGH POWER MILLIMETER WAVE EVALUATION OF FERRITE DEVICES</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - TRONTECH</td>
<td>HIGH FREQUENCY OSCILLATORS AND AMPLIFIERS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - AM CYANAMID, EMCORE, POLYTECHNIC UNIVERSITY</td>
<td>OMVPE GROWTH TECHNOLOGIES</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - MARTIN MARLETTA CORPORATION</td>
<td>MAGNETIC BIASING SYSTEM FOR MICROWAVE TUBES</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - MARTIN GOFMAN ASSOCIATES</td>
<td>MILLIMETER WAVE SUPERCONDUCTOR DETECTORS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - CECOM, BELCORE</td>
<td>EPITAXIAL LIFT-OFF PROCEDURES FOR FIBER OPTIC APPLICATIONS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - NORDEN</td>
<td>FLAT PANEL DISPLAYS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - NEOCERA CORPORATION</td>
<td>SUPERCONDUCTOR TECHNOLOGY</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - KTI</td>
<td>E-Beam CIRCUIT ANALYSIS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - EMC TECHNOLOGY</td>
<td>PROGRAMMABLE MICROWAVE ATTENUATORS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - ADVANCED LITHOGRAPHY GROUP</td>
<td>ION PROJECTION LITHOGRAPHY</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
</tbody>
</table>

### EPS DIRECTORATE IMPLEMENTATION OF THE TECHNOLOGY TRANSFER ACT OF 1986

**COORDINATE R&D AGREEMENTS (CRDAs) IN EFFECT (CONTINUATION)**

#### ELECTRONICS and POWER SOURCES

<table>
<thead>
<tr>
<th>PARTICIPANTS</th>
<th>AREA OF TECHNOLOGY TRANSFER</th>
<th>FOTE/SUB-FOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPSD - ALPHA INDUSTRIES</td>
<td>PLANAR DOPED BARRIER DIODE TECHNOLOGY</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - ELECTRONIC CONCEPT, INC.</td>
<td>HIGH ENERGY DENSITY CAPACITOR TECHNOLOGY</td>
<td>POWER SOURCES</td>
</tr>
<tr>
<td>EPSD - SHIPLEY CORPORATION</td>
<td>DEVELOPMENT OF E-BEAM RESISTS</td>
<td>ADV ELECTRONICS/ MICROMECHANICS</td>
</tr>
<tr>
<td>EPSD - CECOM-RUTGERS UNIVERSITY</td>
<td>ULTRA-HIGH SPEED AND MM WAVE ELECTRONIC DEVICES</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - RUTGERS UNIVERSITY</td>
<td>FERROMAGNETIC AND HIGH TEMPERATURE SUPERCONDUCTING THIN FILMS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - RUTGERS UNIVERSITY</td>
<td>HERMETIC COATINGS FOR OPTICAL WAVEGUIDES</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - RUTGERS UNIVERSITY</td>
<td>SMART CERAMIC MATERIALS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - CECOM-PRINCETON UNIVERSITY</td>
<td>PHOTONIC DEVICES</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - STEVENS INSTITUTE OF TECHNOLOGY</td>
<td>OPTOELECTRONIC DEVICES</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - N.J. INSTITUTE OF TECHNOLOGY</td>
<td>ULTRA-HIGH SPEED AND MM WAVE ELECTRONIC DEVICES</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
<tr>
<td>EPSD - TECHTRON CYCLONETICS, INC.</td>
<td>LOW NOISE DIELECTRIC RESONATOR OSCILLATORS</td>
<td>ADV ELECTRONICS/ MM WAVE</td>
</tr>
</tbody>
</table>
EPSD - SBIR FUNDING

US ARMY RESEARCH LABORATORY

ELECTRONICS and POWER SOURCES

EPSD PHASE I CONTRACTS
EPSD PHASE II CONTRACTS
SBIR CONTRACTS MONITORED BY EPSD

FY-85
FY-86
FY-87
FY-88
FY-89
FY-90
FY-91
FY-92
FY-93

SBIR FUNDING (MILLIONS OF DOLLARS)
# ELECTRONICS AND POWER SOURCES LIST OF POC's

Fort Monmouth, New Jersey 07703-5601  
Area Code (908) DSN (995/992)

<table>
<thead>
<tr>
<th>Name</th>
<th>Position and Office Details</th>
<th>Area Code</th>
<th>Phone Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>DR. CLARENCE G. THORNTON</td>
<td>Directorate Executive AMSRL-EP</td>
<td>(908)</td>
<td>544-2541 (995)</td>
</tr>
<tr>
<td>MR. VINCENT ROSATI</td>
<td>Program Coordination Office AMSRL-EP-C</td>
<td>(908)</td>
<td>544-4651 (995)</td>
</tr>
<tr>
<td>MR. RICHARD STERN</td>
<td>Advanced Concepts and Plans AMSRL-CP-TA Technology-Transfer, Small Business, SBIR Manager</td>
<td>(908)</td>
<td>544-4666 (995)</td>
</tr>
<tr>
<td>MS. REGINA R. VENEZIA</td>
<td>Operations Directorate AMSRL-OP-PR-FM Chief, Contracting and Acquisition</td>
<td>(908)</td>
<td>544-4919 (995)</td>
</tr>
<tr>
<td>MR. CHARLES D. BOYLAN</td>
<td>Operations Directorate AMSRL-OP-PR-FM Competition Advocate</td>
<td>(908)</td>
<td>544-3471 (995)</td>
</tr>
<tr>
<td>MS. MARY HAYES</td>
<td>Advanced Technology Management Office AMSRL-EP-T Unsolicited Proposals</td>
<td>(908)</td>
<td>544-4808 (995)</td>
</tr>
<tr>
<td>DR. MICHAEL TOMPSETT</td>
<td>Electronics Devices AMSRL-EP-E</td>
<td>(908)</td>
<td>544-2452 (995)</td>
</tr>
<tr>
<td>MR. RANDOLPH A. REITMEYER</td>
<td>Microcircuits Design and Components Division AMSRL-EP-I</td>
<td>(909)</td>
<td>544-3465 (995)</td>
</tr>
<tr>
<td>MR. VALDIMIR GELNOVATCH</td>
<td>Microwave/Lightwave Component Division AMSRL-EP-M</td>
<td>(908)</td>
<td>544-4883 (995)</td>
</tr>
<tr>
<td>MR. JOSEPH KEY</td>
<td>Reliability and Manufacturing Science Division AMSRL-EP-R</td>
<td>(908)</td>
<td>544-1258 (995)</td>
</tr>
<tr>
<td>DR. ROBERT HAMLEN</td>
<td>Power Sources Division AMSRL-EP-P</td>
<td>(908)</td>
<td>544-2084 (995)</td>
</tr>
</tbody>
</table>
Research Directions in ARL's Human Research & Engineering Directorate

OUTLINE

1. The HRED Organization
2. Visual Search & Target Acquisition
3. Visual Control
4. Auditory Performance
5. Cognition and Decision Performance
6. Human Factors of the Individual Soldier
7. Crew Station Design
8. MANPRINT Manpower, Personnel, and Training Estimation
9. SBIR's
10. BAA's
11. Resource Distribution
HUMAN RESEARCH & ENGINEERING DIRECTORATE

MISSION

- Conduct broad-based program of scientific research and technology directed toward optimizing soldier performance and soldier-machine interactions to maximize battlefield effectiveness.

- Provide the Army and ARL with Manpower and Personnel Integration (MANPRINT) leadership to ensure that soldier performance requirements are adequately considered in technology development and system design.

VISUAL SEARCH AND TARGET ACQUISITION

1. Effect of Target and Scene Characteristics
   e.g. contrast, size, shape, range and complexity

2. Display Characteristics
   e.g. resolution, stereo, symbology, field of view

3. Observer Characteristics
   e.g. training, experience, spatial and visual abilities
VISUAL CONTROL

1. Visual requirements for vehicular control
   - FOV
   - Resolution
   - Color
   - 3-D

2. Optimization of visual displays for special applications
   - Bandwidth limited teleoperations
   - Night, nap-of-the-earth flight

3. Enhancement of operator's capabilities and reduction of vision-driven workload
   - Perform multiple tasks
   - Control several vehicles

AUDITORY PERFORMANCE

1. Auditory Displays
   Relates to enhanced transmission of information, situational awareness, design of warning and informational signals, etc. Should also be conceived of as symbiotically combined with visual displays.

2. Modeling and Empirical Verification of Auditory Target Detection, Identification and Localization
   Important for stealth/low observable issues - includes both psychoacoustic as well as physical acoustic modeling and research.

3. Soldier/System Performance as a Function of Psychoacoustic Factors
   e.g. - if I don't hear so well (because of wearing hearing protection or hearing loss or noise around me) how does this affect the time to fire, agree on IFF issues, detect the presence of the enemy, etc.
1. Predicting tactical decision making performance with decision aids

2. Measuring staff planning and command decision making performance at:
   - tactical level and
   - operating level
for - logistics
   - maneuver
   - fire support
   - and other functional areas

3. Concepts for intelligent interfaces

4. Concepts for predicting soldier performance in unaided and aided materiel fault diagnosis

Human Factors of the Individual Soldier

- Sensory Enhancement and Encapsulation:
  - Replacement of normal sensory modalities with the output of advance sensors (I2, IR, Audio and multimeter radar) thru advanced display media (Flat Plate and CRT).
  - Information display content, fidelity and control

- Motor and Strength Enhancement:
  - Kinematic degrees of freedom
  - Proprioceptive cueing
  - Force & speed feedback loops
  - Balance and gait constraints

- Virtual Environments:
  - Feasibility of VR and V interface technologies to improve system performance
  - Ergonomic adaptation of VR technologies for individual soldier interactions w/virtual environments

- Human Figure Modelling:
  - Analysis tool development compatible w/CAD/CAE and virtual environment simulations
  - Adaptation of HFM with AI attributes for inclusion of soldiers in the computer generated force environment
Crew Station Design (CSD)
- Broaden & Improve Methods for CSD Process
- CSD for 50 Ton Tank
- Operator Control Units for Unmanned Ground Vehicles

MHE & PLS Enhancements
- MHE & PLS Enhancements
- Field Trials for FARV Resupply of LP Projectiles & Fuel to AFAS
- Control & Supervision of Robots & Precision Manipulators

MANPRINT Manpower, Personnel and Training Estimation
- Methods are needed for estimating operator and maintenance factors in automated information systems.
93.2 SBIR Solicitations Topics

- Fire Support Suppression Effects in Battlefield Simulation
- Human Performance Issues in Automatic Target Recognition and Situation Awareness Displays
- Development of Performance and Effectiveness Measures to Support Evaluations of Unmanned Ground Vehicles (UGV) Technologies and Operations
- Development of an Unmanned Ground Vehicle (UGV) Simulator

93 ARL BAA HRED Research Topics

- Simulation and Human Modeling
- Intelligent Decision Aids and Interfaces
- Human Information Processing
- Perceptual, Cognitive and Psychomotor Performance
- Knowledge-Based Reasoning
- MANPRINT Assessment Techniques for Maintenance Activities
- MANPRINT Integration Methods
- MANPRINT Design Analysis
Resource Distribution
HRED Mission Funding $ & Mission Contracts for FY90 - FY98 (Historical-Estimated)

Note: Does not include Direct Cite Fund $ or Direct Cite Contract $
ARMY RESEARCH LABORATORY

Vehicle Structures

Dr. Wolf Elber
Directorate Executive
Vehicle Structures (VSD)
(804) 864-3949
ARMY ~ NASA JOINT AGREEMENT

ARMY RESEARCH LABORATORY/NASA LANGLEY RESEARCH CENTER

PURPOSE: Joint participation in vehicle structures research

ARMY AGREES: Participate in rotary wing/structures research

Establish an Army Office
Provide Army employees
Conform to all Langley operational requirements
  - Safety
  - Security
  - Work procedures

NASA AGREES: Make available facilities
Provide equipment, services, supplies, offices
Publish research results
Provide necessary accounting information
Provide contractual and personnel support

AERIAL VIEW OF

NASA LANGLEY RESEARCH CENTER
5-YEAR TECHNICAL THRUSTS

Structural Integrity
Provide integrated stress-strength-inspection technology for life-extension of existing and durability of future aero and ground vehicles

Advanced Design
Provide new ideas in composites/hybrid applications technology together with formal analytical design optimization tools

Structural Dynamics
Validate and refine analytical models for multi-body kinematics and dynamics to support vehicle loads analysis and vibration reduction

Aeroelasticity
Refine testing capability and analytical prediction methodology for vibration-free rotorcraft designs
STRUCTURAL INTEGRITY THRUST

PROVIDE INTEGRATED STRESS-STRENGTH-INSPECTION TECHNOLOGY FOR LIFE EXTENSION OF EXISTING AND DURABILITY OF FUTURE ARMY AVIATION AND GROUND VEHICLES

OBJECTIVES:

• ADVANCED STRUCTURAL ANALYSIS APPLICATIONS TO VALIDATE DESIGN TOOLS FOR COMPOSITE STRUCTURES

• COMPOSITE DELAMINATION FAILURE CRITERIA TO PREDICT ONSET AND PROGRESSION OF DAMAGE, FATIGUE DURABILITY, AND DAMAGE TOLERANCE

• ADVANCED NDE METHODS FOR FIELD INSPECTION AND MANUFACTURING QA TO ENHANCE STRUCTURAL INTEGRITY AND TO REDUCE O&S COSTS OF ARMY VEHICLES

STRUCTURES TECHNOLOGY FOR AVIATION AND GROUND VEHICLES
ADVANCED DESIGN THRUST

PROVIDE NEW IDEAS IN COMPOSITES/HYBRID APPLICATIONS
TECHNOLOGY TOGETHER WITH FORMAL ANALYTICAL DESIGN
OPTIMIZATION TOOLS

OBJECTIVES:
• DESIGN, FABRICATE, AND TEST ADVANCED AIRFRAME STRUCTURES TO ACHIEVE IMPROVED OPERATIONAL CAPABILITIES AT LOWER WEIGHT, LESS COST, AND INCREASED DURABILITY

• DEVELOP MANUFACTURING TECHNOLOGY WHICH MAKES THROUGH-THE-THICKNESS REINFORCED COMPOSITES COST EFFECTIVE TO PRODUCE WITH EXISTING TEXTILE MACHINERY

• DEVELOP OPTIMIZATION AND DISCIPLINE INTEGRATION TECHNIQUES INTO ROTORCRAFT DESIGN TO IMPROVE PRODUCT PERFORMANCE

PHOTO OF IMPACT DYNAMICS FACILITY
STRUCTURAL DYNAMICS THRUST

VALIDATE AND REFINE ANALYTICAL MODELS FOR MULTI-BODY KINEMATICS AND DYNAMICS TO SUPPORT VEHICLE LOADS ANALYSIS AND VIBRATION REDUCTION

OBJECTIVES:

• CONDUCT A COMPREHENSIVE TEST PROGRAM TO CHARACTERIZE DAMAGE DEVELOPMENT IN SCALED COMPOSITE TENSILE COUPONS

• DEVELOP AND VERIFY SCALING LAWS FOR COMPOSITE MATERIALS AND LAMINATES TO IMPROVE SMALL SCALE TEST CAPABILITIES

• EVALUATE BENEFITS TO INTERIOR NOISE BY INNOVATIVE USE OF ACTIVE NOISE CONTROL AND ADVANCED MATERIALS

• DEMONSTRATE FEASIBILITY OF USING ENERGY ABSORBING COMPOSITE STRUCTURES BY MODIFYING METAL SUBFLOORS ON COMPOSITE AIRCRAFT

AERIAL PHOTO OF
TRANSONIC DYNAMICS TUNNEL
(TDT)
AEROELASTICITY THRUST

REFINE TESTING CAPABILITY AND ANALYTICAL PREDICTION METHODOLOGY FOR VIBRATION-FREE ROTORCRAFT DESIGNS

OBJECTIVES:

- ENHANCE EXPERIMENTAL HARDWARE CAPABILITY IN THE TRANSONIC DYNAMICS TUNNEL (TDT) TO IMPROVE VERSATILITY AND EFFICIENCY OF MODELING ADVANCED ROTORCRAFT.
- DEVELOP ANALYTICAL AND EXPERIMENTAL TOOLS TO UNDERSTAND AND MINIMIZE FIXED AND ROTATING SYSTEM HELICOPTER VIBRATORY LOADS.
- VALIDATE FINITE ELEMENT PREDICTION (MSC-NASTRAN) OF MODAL PROPERTIES OF EXISTING TDT ROTORCRAFT ROTATING SYSTEMS.

VEHICLE STRUCTURES DIRECTORATE

TECHNOLOGY TRANSFER OPPORTUNITIES

1992 Tech Transfer Meeting
(Over 50 Industry/Academia/Government Attendees)

IR&D Plans/Reviews
(Rotorcraft and Ground Vehicle Industry)

VSD's Quadchart Program Descriptions

Cooperative Research & Development Agreements
(Six in Place)
PHOTO OF SMOKE TEST IN TUNNEL

SUMMARY

Joint Army-NASA Agreement gives Army maximum research capabilities at minimum cost

VSD pro-active in technology transfer efforts (Tech Transfer Office)

Research opportunities expanding
Army Research Laboratory

Advanced Computational & Information Sciences

Dr. Andrew Mark
Chief (acting)
Simulation Technology Division
Advanced Computational and Information Sciences Directorate (ACIS)
(410) 278-9760
Advanced Computing, Simulation & Software

Briefing to Industry

Presented By

Dr. Andrew Mark
Chief, Simulation Technology Division
Advanced Computational & Information Sciences Directorate

ARMY RESEARCH LABORATORY

Organization
Thrusts

* High Performance Computing/Communications
* Software Technology
* Simulation Technology

Projected ACIS Budget
Technical Areas

High Performance Computing/Communications
Vector & Massively Parallel Processing
Local and Wide Area IP Networks
Distributed Computing
Scientific Visualization

Software Technology
Artificial Intelligence
Expert Systems
Information Systems
Information Distribution Technology

Simulation Technology
Technology and Material/Materiel Assessment
Virtual Factory
Virtual Reality for the Individual Soldier
Louisiana Maneuvers

Unique Facilities

• Existing
  • Cray-2 Vector Processor
  • Cray X-MP/48 Vector Processor
  • Touchstone Gamma Machine
  • Various Mini/Superminis (Convex, Digital, Encore, etc.)
  • Access to CM-200, CM-5
  • ASNET, DISNET, ARLNET

• Soon to be Realized
  • Access to major vector processor (unclassified)
  • Upgrade to major vector processor (classified)
  • Scalable MPP with novel architecture
  • DREN
LONG RANGE GOALS:

- Develop technology in the form of strategies, techniques, algorithms, and the assessment of architectures to provide high performance computing for the solution of scientific and engineering problems of interest to ARL, AMC and the Army.

- Provide ARL and the Army with state-of-the-art computational capability, particularly in classified and massively parallel processing.

- Make significant contributions to the President’s initiative on Strategic Computing.

- Provide ARL and the Army with state-of-the-art high speed technical data communications.

High Performance Computing Project Details

- High Performance Computing
  - Objective: To best position the ARL and the Army to understand, assess, acquire and exploit the best large scale scientific computer technology for application to problems of interest and concern to the technology base.
  - A diverse set of activities.
  - Provides funding for:
    - Classified and unclassified visualization centers,
    - Collaborative efforts with U. of Md. (CM-2),
    - Undergraduate program in HPC at Howard U.,
    - CEM and CFD codes with Industry Partners,
    - Collaborative efforts with AHPCRC (SciVis, MPP),
    - Collaborative efforts with DOE labs (MESA, PAGOSA, CTH, PCTH),
    - Collaborative efforts with DARPA (IPSC/860, NCHPC),
    - General MPP and HPC support to Directorates of ARL and RDEC's of AMC.
Programs in HPC/C

DoD HPC/C Modernization Program:
- Replace existing SC assets with stable systems
- Acquire early access to advanced systems
- Establish HPC-Neural Networking Capability
- Provide Tri-Service prepaid computing

Infrastructure to support HPC/C and Distributed Computing

Army High Performance Computing Research Center

Specific HPC/C Programs

Acquire Stable Systems:
- FY93/4 - Network-Robotic Mass Storage - $1.5M
- FY94 - Replacement Classified System - $30M
- FY95 - Augmentation - $15M

Acquire Early Access Systems:
- FY94 - BAA for Scalable Architectures - $2.5M
- FY95 - BAA for Scalable Architectures - $5M

Establish DRLN Networking Capability:
- FY93 - Phase I - $6M
- FY94 - Phase II - $10M

POC: Mr. Tony Pressley
ATTN: AMSRL-CI-A
Army Research Laboratory
Aberdeen Proving Ground, MD 21005-5067
(410) 278-6509 FAX (410) 278-5077
Basic Research - ARO Program

- Provides 6.1 funding for basic research in mathematics and computer science to support High Performance Computing Initiative.
- Provides the funding and contract monitoring support for the Army High Performance Computing Research Center (AHPCRC).
- Provides the infrastructure for proposal review, contract awards, and contract performance monitoring in the area of basic research.
- Research topics are most general and include algorithms, data structures, high level languages, etc.

Software Technology

LONG RANGE GOALS:
- Provide the Army and ARL with research into state-of-the-art information systems software products and modernized software systems.
- Develop distributed group decision support systems.
- Devise and apply expert systems to Army applications.
- Perform research into and apply Information Distribution Technology to Army systems.
- Develop scientific computing algorithms for scalable parallel architectures.
Programs in Software Technology

- Experiments in information distribution technology with high level applications
- Re-engineering research program
- Research in collaborative work environments
- MPP algorithm development
- Specific-applications for expert systems

Specific Projects in Software Technology

ACTS/IDSN Satellite Experiment
FY93 - Evaluate common capability - $0.2M

Group Decision Support Systems
FY93 - Apply consolidated system to ARL - $0.3M
FY94 - Develop distributed GDSS - $0.4M

Re-engineering
FY93 - Select significant system for re-engineering - $0.2M
FY94 - Complete re-engineering demo - $0.2M

POC: Dr. James Gossif
ATTN: AMSRL-CI-CD
Army Research Laboratory
115 O'Keefe Building
Georgia Institute of Technology
Atlanta, GA 30332-0808
(414) 894-3104 FAX (414) 894-3142
LONG RANGE GOALS

- Develop a capability for the assessment of materiel/materials and novel technologies in a simulated battlefield environment through a Technology Assessment Center.
- Develop valid, verified physical and engineering models for the evaluation of advanced and emerging ARL technologies in wargame settings.
- Perform research into physical and process models to enable the development of a virtual factory.
- Develop and create a virtual environment for the individual soldier which will enable technology development and training.

Programs in Simulation Technology

- Technology Assessment Center
- Tech Base Seminar Wargames
- 1-PORT (Individual Portal into Simulation)
- Louisiana Maneuvers
- Virtual Factory
- Virtual Environments for ARL
Specific Projects in Simulation

SOFTWARE TECHNOLOGY

Virtual Factory
FY93 - Composite Materials R&D Modeling - $0.3M
FY93 - Matrix Metals R&D Modeling - $0.3M
FY94 - Weapon Component Mfg Process Modeling - $0.5M

Virtual Environments
FY93 - Hardware for simulation - $1.4M
FY94 - Develop simulation environment - $1.0M

The Louisiana Maneuvers (ARL Support)
FY93 - Weather simulation, KBLPS, etc to LAM - $1.0M
FY94 - Other ARL products to LAM - $1.0M
Design the 93 TBSWG - $1.0M

POC: Dr. Kurt Fickie
ATTN: AMSRL-CI-S
Army Research Laboratory
Aberdeen Proving Ground, MD 21005-5067
(410) 278-6858 FAX (410) 278-5075

Cooperative and Collaborative Programs

SOFTWARE TECHNOLOGY

- National Consortium for High Performance Computing
  - NCCHIP = DARPA <-> DoD Labs <-> Industry <-> Academe

- Virtual Factory
  - ARL <-> U. of Del. <-> U. Minn <-> Industry
  - CRADA's between ARL & Industry

POC: Mr. Harold Bremen
ATTN: AMSRL-CI-A
Army Research Laboratory
Aberdeen Proving Ground, MD 21005-5067
(410) 278-6259 FAX (410) 278-5077

POC: Dr. Kurt Fickie
ATTN: AMSRL-CI-S
Army Research Laboratory
Aberdeen Proving Ground, MD 21005-5067
(410) 278-6858 FAX (410) 278-5075
Survivability/Lethality Analysis

Dr. Jack Wade
Directorate Executive (acting)
Survivability/Lethality Analysis (SLAD)
(505) 678-1196
(410) 278-6342
MISSION

Survivability/Lethality Analysis Directorate

- Determine the survivability and lethality of Army systems to the full spectrum of battlefield threats:
  - Ballistic
  - Electronic Warfare
  - Nuclear
  - Chemical and Biological
  - Directed Energy

GOALS AND OBJECTIVES

Survivability/Lethality Analysis Directorate

- Understand how systems function in a multi-threat environment.

- Enhance system survivability and lethality through the application of the best available technology.

- Provide technical assistance to Army managers and decision makers throughout the system acquisition process.
MAJOR FUNCTIONS

- Conduct investigations, laboratory and field experiments, simulations and analyses to quantify system survivability and lethality.

- Provide objective judgements on complex technical issues regarding system survivability and lethality.

- Serve as the Army focal point for technical advise and consultation on survivability and lethality issues.

- Conduct studies and make recommendations regarding design and/or operational techniques to enhance system survivability/lethality.

DIRECTORATE ORGANIZATION
• System analyses planned and executed through an integrated analysis team (IAT) process.

• Threat and technical disciplines will be integrated at the working level instead of at the system management level.

• Current IAT structure:
  - Air Defense
  - Aviation
  - C4/IEW
  - Ground Systems
  - Munitions

MODELS/SIMULATIONS

• Ballistic Component and Compartment
• Stochastic Component (SQUASH)
• Stochastic Processor of Artillery Effectiveness (SPRAE)
• Army Unit Resiliency Analysis (AURA)
• Surface-to-Air Missile Sites Mean Area Effectiveness (SAMSMAE)
• Non-Uniform Simple Surface Evaporation (NUSSE)
• EPLRS/MSE System Performance
• EOCM missile flight simulation
• Open-loop Tracking Complex
• Air-to-Surface Missile Simulation
• Anti-Tank Guided Missile Simulation
• Electromagnetic coupling
UNIQUE FACILITIES/CAPABILITIES

- SEMIVAF (WSMR)
- Millimeter Wave Measurement Facility (WSMR)
- BIG CROW (Kirtland AFB)
- Combat Vehicle Ballistic Range (APG)
- Aircraft Ballistic Vulnerability Experimental Facility (APG)
- Smoke Week

TECHNICAL AREAS

Ballistic Vulnerability/Lethality Division

- Vulnerability analysis:
  - Armored systems
  - Air systems
- Lethality analysis:
  - Anti-armor and artillery munitions
  - Air defense systems
- Armor/anti-armor concepts evaluation.
- Live Fire/Joint Live Fire - ground and air systems.
- Geometric and materiel modeling.
- Computer aided vulnerability/lethality analysis.
- Advanced computer technology.
- Analysis of unit level operations.
- Personnel vulnerability analysis.
- Spare parts requirements predictions.
- Foreign materiel exploitation.
INDUSTRY OPPORTUNITIES
Ballistic Vulnerability/Lethality Division

Survivability/Lethality Analysis Directorate

- Vibrational analysis and wind tunnel testing of helicopters with damaged rotor blades.
- Formulation of algorithms for flight dynamics analysis.
- Evaluation of flight dynamics and controllability of aircraft with damaged flight controls and/or surfaces.
  (Video output showing aircraft behavior)
- Generation of geometric target descriptions.
- Develop database to catalog and annotate existing vulnerability data.
- Conduct sensitivity analyses to determine the influence of component PK/H quality on analysis results.

TECHNICAL AREAS
Electronic Warfare Division

Survivability/Lethality Analysis Directorate

- Electronic warfare vulnerability assessment (EWVA):
  - Theoretical analyses
  - Laboratory measurements
  - Field experiments

- Signature measurements:
  - Spatial, spectral, and temporal
  - RF, IR, visible, acoustic and seismic
  - U.S., threat targets, and countermeasure devices

- Electronic warfare support:
  - EW environments
  - Data acquisition, processing and analysis
  - Simulators/emulators
  - Known, expected and reactive threats
TECHNICAL PROGRAMS
Electronic Warfare Division

Programs which may require industry support include:
- Missile defense
- Air defense
- Aviation
- Close combat
- C4I

Programs range from small to large and include:
- National/Theater Missile Defense - GBI/GBR, THAAD, PAC-3
- Command, Longbow Apache
- C4I - ATCCS, MSE, SICPS, CHS
- Mines - FASCAM, WAM
- Munitions - BAT, SADARM
- JSTARS

INDUSTRY OPPORTUNITIES
Electronic Warfare Division

Engineering services to support ongoing EWVA.
Improved analysis tools, techniques, methodologies.
Computer virus protection concepts.
Concepts to effectively make multi-spectral measurements.
Concepts/approaches to measure signatures in all three (spatial, spectral and temporal) dimensions simultaneously.
Wavelet coupling theory.
High power microwave diagnostics and antenna characterization.
INVESTMENT STRATEGY

- 80% of mission funding (6.5) to be allocated to systems analyses through the SLA process.

- 20% of mission funding (6.2) to be used to develop tools, techniques and methodologies in direct support of system analysis efforts.

- Customer funding (PEO/PM, RDEC, etc.) to be used to support specific customer requirements.

FINANCIAL OUTLOOK

- Mission funding: $50 million per year.

- Customer funding: $15 - $20+ million per year.

- Internal costs: approximately 85% of total funding. (Includes approximately $20 million for multi-year support contracts.)
TECHNICAL AREAS
Nuclear/Biological/Chemical Effects Division
Survivability/Lethality Analysis Directorate

- PEO/PM support:
  - Program management
  - Technical and analytical
  - Expert system development
- Database development and management.
- Chemical Defense Materials Database.
- Materials test methodology development.
- Smoke/obscurant effectiveness studies.
- Smoke Week.
- Agent dispersion models.
- Analysis methodology development.
- Electromagnetic coupling models.
- Soldier vulnerability.

INDUSTRY OPPORTUNITIES
Nuclear/Biological/Chemical Effects Division
Survivability/Lethality Analysis Directorate

- Multi-disciplinary analytical support (blast/thermal radiation, initial nuclear radiation, electromagnetic pulse, and chemical/biological) for planned efforts in air defense, aviation, C4I, ground systems and munitions.

- Support to PEO/PM:
  - Awareness training
  - Expert system(s)
  - Program management tools/documentation
POINTS OF CONTACT

Survivability/Lethality Analysis Directorate

- **General Information:** Dr. Jack Wade, 410-278-6342 or 505-678-1196
  Dr. Michael Starks, 410-278-6828
  Army Research Laboratory, AMSRL-SL-I
  Aberdeen Proving Ground, MD 21005-5001

- **Ballistics:**
  Dr. Paul Deitz, 410-278-6282
  Army Research Laboratory, AMSRL-SL-B
  Aberdeen Proving Ground, MD 21005-5001

- **Electronic Warfare:** COL George Lasche, 505-678-2256
  Directed Energy
  Army Research Laboratory, AMSRL-SL-E
  White Sands Missile Range, NM 88002-5513

- **NBC:**
  Mr. Mike Miller, 410-671-8421
  Army Research Laboratory, AMSRL-SL-N
  Aberdeen Proving Ground, MD 21010-5423
U.S. ARMY RESEARCH LABORATORY
FY 93 ADVANCE PLANNING BRIEFING
FOR INDUSTRY

OPERATIONS DIRECTORATE
PROCUREMENT DIVISION

INFORMATION PACKET
JANUARY 28, 1993
WHITE OAK, MD
FY 93 ACQUISITION PLAN
ARL SUMMARY

- TOTAL ESTIMATED OBLIGATIONS: $296 MILLION, 1299 PLANNED PROCUREMENT ACTIONS

- OF THIS AMOUNT, 476 ACTIONS AND $118 MILLION ARE INCREMENTAL FUNDING MODIFICATIONS

- THE PLAN INCLUDES 52 NEW SBIR PHASE I CONTRACTS, ESTIMATED AT ABOUT $2.6 MILLION

- ARL PLANS 30 NEW SBIR PHASE II CONTRACTS, ESTIMATED OBLIGATION OF ABOUT $6.5 MILLION

- ARL PLANS 122 NEW BAA CONTRACTS, ESTIMATED OBLIGATION OF ABOUT $31.8 MILLION
FY 93 ACQUISITION PLAN
ARL SUMMARY

ESTIMATED OBLIGATIONS IN MILLIONS

TOTAL ARL INCR FND NEW BAA NEW SBIR II NEW SBIR I

$300
$298
$250
$0

FY 93 ACQUISITION PLAN
ARL SUMMARY

NUMBER OF ACTIONS

TOTAL ARL INCR FND NEW BAA NEW SBIR II NEW SBIR I

1600
1400
1200
1000
800
600
400
200
0

1299
476
122
30
52
## RECURRING ARL CONTRACT REQUIREMENTS

<table>
<thead>
<tr>
<th>CONTRACTOR:</th>
<th>Description:</th>
<th>CONTRACT AMT:</th>
<th>EXPIRATION DATE:</th>
<th>COMPETITIVE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Dynamics Corp., Ft. Worth, TX</td>
<td>Design, Fabrication, and Maintenance of SADS</td>
<td>$4,661,849</td>
<td>052293</td>
<td>YES</td>
</tr>
<tr>
<td>Colsa Inc., Huntsville, ALA</td>
<td>Engineering Support for FMD ATGM</td>
<td>$2,493,272</td>
<td>013093</td>
<td>UNKNOWN</td>
</tr>
<tr>
<td>Optimetrics, Inc., Ann Arbor, MI</td>
<td>Measurement Support</td>
<td>$2,946,909</td>
<td>083194</td>
<td>UNKNOWN</td>
</tr>
<tr>
<td>Regents of NMSU, Las Cruces, NM</td>
<td>Air Defense &amp; Space Systems EW Support</td>
<td>$9,930,760</td>
<td>063095</td>
<td>UNKNOWN</td>
</tr>
<tr>
<td>Syndetix, Inc., Las Cruces, NM</td>
<td>Engineering Services and Materials</td>
<td>$3,344,537</td>
<td>041595</td>
<td>YES</td>
</tr>
</tbody>
</table>
## RECURRING ARL CONTRACT REQUIREMENTS

| CONTRACTOR: | Concurrent Computer Corporation  
| Richardson, TX |
| DESCRIPTION: | Computer Maintenance of FMMS System |
| CONTRACT AMT: | $155,206.92 |
| EXPIRATION DATE: | 093097 |
| COMPETITIVE: | YES |

| CONTRACTOR: | Management Assistance Corp of America  
| El Paso, TX |
| DESCRIPTION: | Financial/Administrative Management Information Services |
| CONTRACT AMT: | $3,251,206 |
| EXPIRATION DATE: | 093094 |
| COMPETITIVE: | YES |

| CONTRACTOR: | Regents of NMSU, Las Cruces, NM |
| DESCRIPTION: | Scientific, Engineering and Technical Support Services |
| CONTRACT AMT: | $8,478,412 |
| EXPIRATION DATE: | 063094 |
| COMPETITIVE: | UNKNOWN |

| CONTRACTOR: | Geocenters, Inc. Newon Centre, MA |
| DESCRIPTION: | Equipment and Facility Maintenance |
| CONTRACT AMT: | $4,474,093 |
| EXPIRATION DATE: | 011894 |
| COMPETITIVE: | UNKNOWN |

| CONTRACTOR: | Vitronics, Inc. Eatontown, NJ |
| DESCRIPTION: | On site operation and maintenance support of laboratory equipment |
| CONTRACT AMT: | $5,629,029 |
| EXPIRATION DATE: | 011795 |
| COMPETITIVE: | UNKNOWN |

| CONTRACTOR: | General Technical Services, Inc.  
| Wall Township, NJ |
| DESCRIPTION: | Technical & Administrative Support Service |
| CONTRACT AMT: | $803,415 |
| EXPIRATION DATE: | 061495 |
| COMPETITIVE: | UNKNOWN |
## RECURRING ARL CONTRACT REQUIREMENTS

<table>
<thead>
<tr>
<th>CONTRACTOR: Vitronics, Inc. Eatontown, NJ</th>
<th>DESCRIPTION: Equipment, test bed &amp; facility operation and maintenance support services</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTRACT AMT: $1,941,039</td>
<td>EXPIRATION DATE: 093095</td>
</tr>
<tr>
<td>COMPETITIVE: UNKNOWN</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTRACTOR: Applied Dynamics International Ann Arbor, MI</th>
<th>DESCRIPTION: Hardware &amp; Software Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTRACT AMT: $150,157.50</td>
<td>EXPIRATION DATE: 093095</td>
</tr>
<tr>
<td>COMPETITIVE: NO</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTRACTOR: Compatible Micro Solutions, El Paso, TX</th>
<th>DESCRIPTION: ADP Services to develop, maintain and utilize software &amp; hardware tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONTRACT AMT: $609,921</td>
<td>EXPIRATION DATE: 043095</td>
</tr>
<tr>
<td>COMPETITIVE: NO</td>
<td></td>
</tr>
</tbody>
</table>

## ARL PROCUREMENT SITE FORECAST OBLIGATIONS

<table>
<thead>
<tr>
<th>ADELPHI</th>
<th>FORT MONMOUTH</th>
<th>WATERTOWN</th>
<th>WHITE SANDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$92.7</td>
<td>$89.5</td>
<td>$22.1</td>
<td>$22.2</td>
</tr>
</tbody>
</table>
FY 93 SMALL BUSINESS FORECAST

SMALL BUSINESS $54.6M (28%)
SMALL DISADVANTAGED BUSINESS $11.7M (6%)

USING THE ARL BROAD AGENCY ANNOUNCEMENT (BAA)

Each attendee at this conference will receive a copy of the ARL BAA (FY93). The ARL BAA is a comprehensive listing of research and development topics of interest to ARL technical directorates. You are encouraged to review this document and submit proposals for those topics that are of interest to you. Each topic in the BAA lists a technical point of contact. You may contact them with any technical questions. Non-technical questions regarding the BAA should be directed to:

Henry J. Mehler
Army Research Laboratory
ATTN: AMSRL-OP-PR-WT
Watertown, MA 02172-0001
(617)923-5005