



**RDECOM**



# SOLDIER SURVIVABILITY 2012

# ARL

"Rebalancing Army Forces and Resources:  
MANPRINT is Right and Ready for the Challenge"

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**

## 2012 MANPRINT WORKSHOP

September 25-26, 2012



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- **MANPRINT Starts 1987 – MG Thurman**
- **AR 602-2 “Manpower & Personnel Integration in the System Acquisition Process”**
- **1992: CSA GEN Sullivan asks if Someone Could Address Fratricide – DCSPER LTG Carney Volunteered MANPRINT to do so**
- **MANPRINT Directorate Decided Upon a New Domain to Address Fratricide Plus Five Other Components**
- **1993: Dr. Don Headley – ARL-HRED; - MAJ Mitchell Howell – HQDA MANPRINT; - Rich Zigler – ARL-SLAD; with Assistance by ARL-HRED’s Rick Tauson & Bill Doss**
- **1994: Committee of 20+ Developed the 180 Initial Issues of the Parameter Assessment List; Staffing of Changes to AR 602-2**
- **1994: Many Briefings & ARL-HRED Director Dr. Keesee’s Assistance to Gain Army Support for Soldier Survivability Domain;**
- **7 October 1994: Soldier Survivability Domain Established**

“The Commanding General (CG, AMC) will–

- *d.* Through the Director, U.S. Army Research Laboratory-Survivability/Lethality Analysis Directorate (ARL-SLAD)–
- (1) Provide technical ((survivability/lethality/vulnerability) issues related but not limited to conventional **ballistics, nuclear, biological, and chemical (NBC), NBC-contamination survivability, electronic warfare, electronic warfare vulnerability of tactical communications systems, information operations/information warfare, atmospherics/obscurants, directed energy weapons, jamming, electronic countermeasures, and personnel vulnerability**) advice and assistance to ICTs and PM IPTs on Soldier Survivability (SSv) of combat systems (see AR 70-75, Survivability of Army Personnel and Materiel para 2-18d(1)).

\* MANPRINT: “MANPOWER AND PERSONNEL INTEGRATION (MANPRINT) in the System Acquisition Process”

## **Parameter Assessment List (PAL):**

- **6 Components**
- **180 Issues Potentially Affecting Survivability**

## **Assessment Ratings Assigned Based Upon:**

- **Magnitude of Impact on Soldier or System**
- **Probability of the Deficiency Occurring**

**Report Sent to PM, HQDA MANPRINT, & ARL-HRED**

Soldier survivability deficiencies ratings and color ratings, as a function of bodily injury, system damage

## SSv SEVERITY RATING

Bodily Injury					
		Life-Threatening / Death (Loss of Life or Major Limb if Not Medically Treated within 1 hour)	Serious (Loss of Life or Major Limb if Not Medically Treated within 24 hours)	Mild (Loss of Performance if Not Medically Treated within 24-72 hours)	Negligible (Medical Treatment Optional, for Comfort or Prevent Infection, Performance Capability Unaffected)
System Degradation					
Probability of Occurrence		Loss of All Capabilities	Heavy	Light or Mild	Negligible
	Frequent	Critical	Critical	Critical	Major
	Occasional	Critical	Critical	Major	Minor
	Remote	Critical	Major	Minor	Minor
	Improbable	Major	Minor	Minor	Minor

**NOTES:**

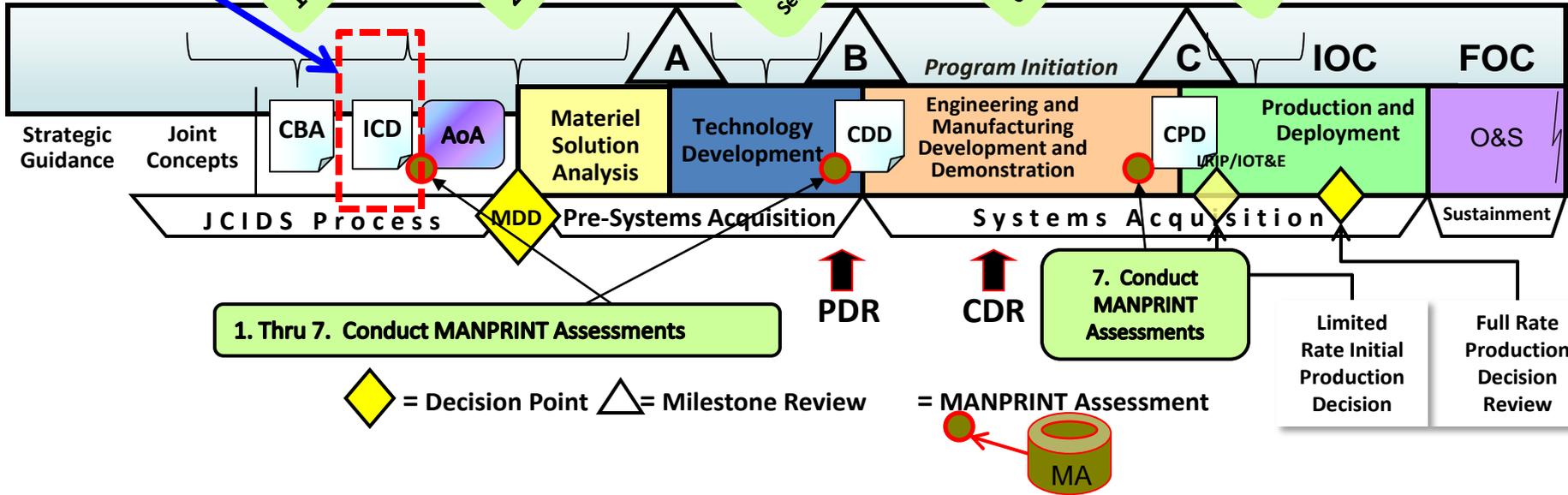
**Critical:** System characteristics which create one of the following combinations of probability and magnitude (Occurrence/[Bodily Injury+System Damage]): (i) Remote AND [Life threatening or death OR Loss of system]; (ii) Occasional AND [Serious or greater OR Heavy or loss of system]; or (iii) Frequently AND [Mild or greater OR Light or greater loss of system]. Usually but always a rating of “Critical” indicates that development of the system should not continue unless the issue is resolved.

**Major:** System characteristics causing a combination of probability and magnitude (Occurrence/[Bodily Injury+System Damage]): (i) Improbable AND [Life threatening or death OR Loss of system]; (ii) Remote AND [Serious OR Heavy]; (iii) Occasional AND [Mild OR Light]; and (iv) Frequently AND [Negligible OR Negligible]. A “Major” rating indicates that the deficiency may not be sufficiently serious to halt the program, but resources should be allocated to alleviate or reduce the deficiency.

**Minor:** System characteristics which create one of these combinations of probability and magnitude (Occurrence/[Bodily Injury+System Damage]): (i) Improbable AND [Negligible to Serious OR Negligible to Heavy]; (ii) Remote AND [Mild or Negligible OR Light or Negligible]; (iii) Occasional AND [Negligible OR Negligible]. A rating of “Minor” is used to indicate deficiencies that are not essential to program completion, but which would enhance system performance if resolved.

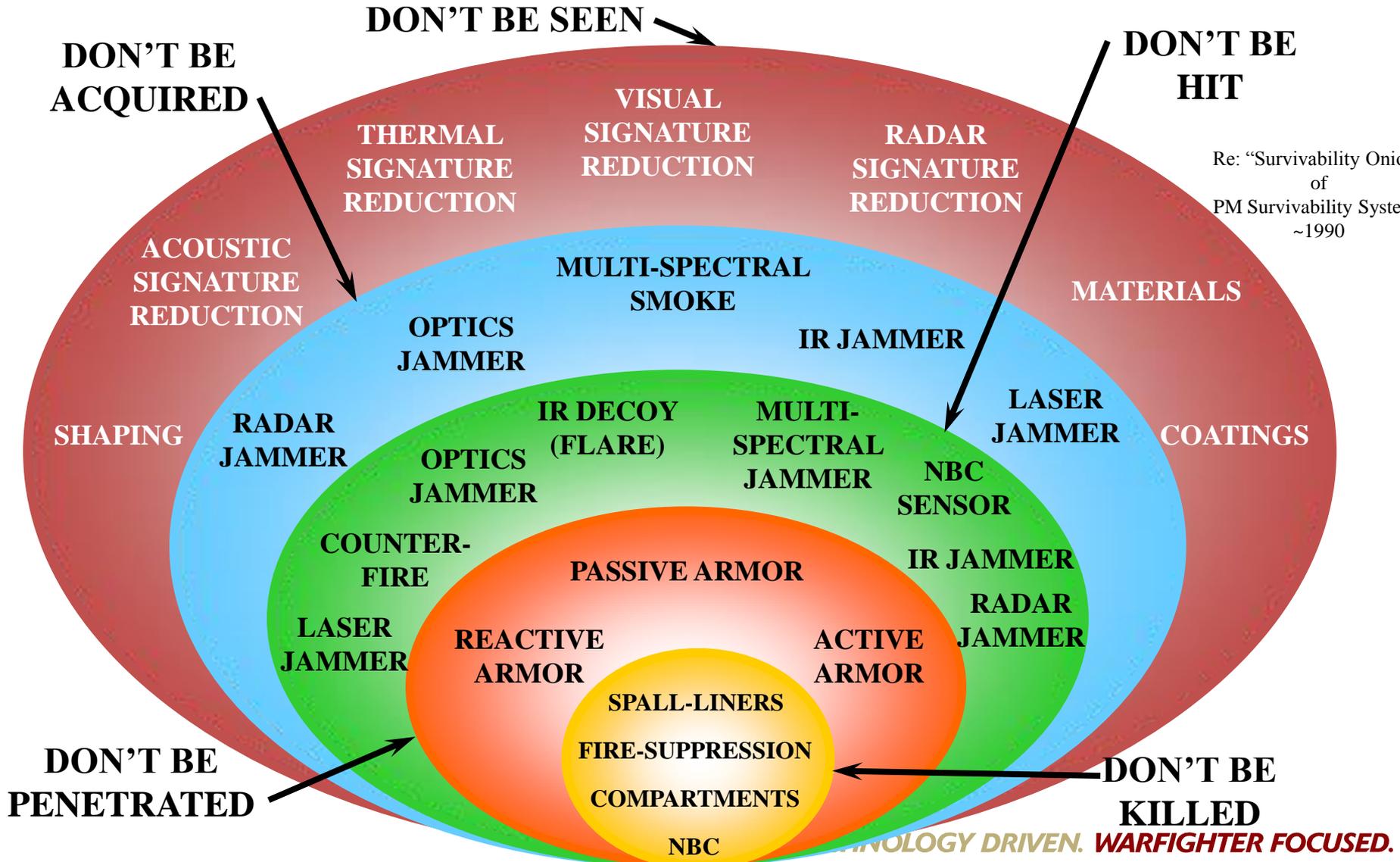


1. Initiate MANPRINT Analysis Early
2. Identify Issues – Plan Analysis
3. Ensure MANPRINT Language in Capability & Acquisition Documents
4. MANPRINT Criteria and Participation in RFP/ Source Selection
5. Execute Integrated Technical Process
6. Conduct Proactive Trade-Offs



CBA=CAPABILITIES-BASED ASSESSMENT; ICD=INITIAL CAPABILITIES DOCUMENT; AOA= ANALYSIS OF ALTERNATIVES; MDD=MATERIAL DEVELOPMENT DECISION; CDD=CAPABILITY DEVELOPMENT DOCUMENT; CPD=CAPABILITY PRODUCTION DOCUMENT; LRIP=LIMITED RATE INITIAL PRODUCTION; IOT&E=INITIAL OPERATIONAL TEST & EVALUATION; O&S=OPERATION & SUSTAINMENT; PDR=PRELIMINARY DESIGN REVIEW; CDR=CRITICAL DESIGN REVIEW

- **Parameter Assessment List – Create “Strawman” Issues List.**
- **Meet with Organization POCs to Review Issue Status and *Select Issues* to be Assessed - *EARLY*.**
- ***ONGOING Issue Resolution* Thru Each Acquisition Phase.**
- **Add New Issues as Appropriate.**
- **Periodic Review of Issues.**
- **Meet with Organization POCs to Review Issue Status for Completeness & Assign Severity Rating to each Issue.**
- **Prepare Report for Support of Upcoming Milestone.**
- **Report Routing.**
- ***Be Proactive.***



**TRADOC Capabilities**

**Understand the Design**

**Personnel Placement**

**Know the Threats**

**Ballistic Design & Testing**

**Survivability**

**Mission Sustainment**

**Antennas & Electromagnetic Environmental Effects (E3)**

**Emergency Egress (Land & Water)**

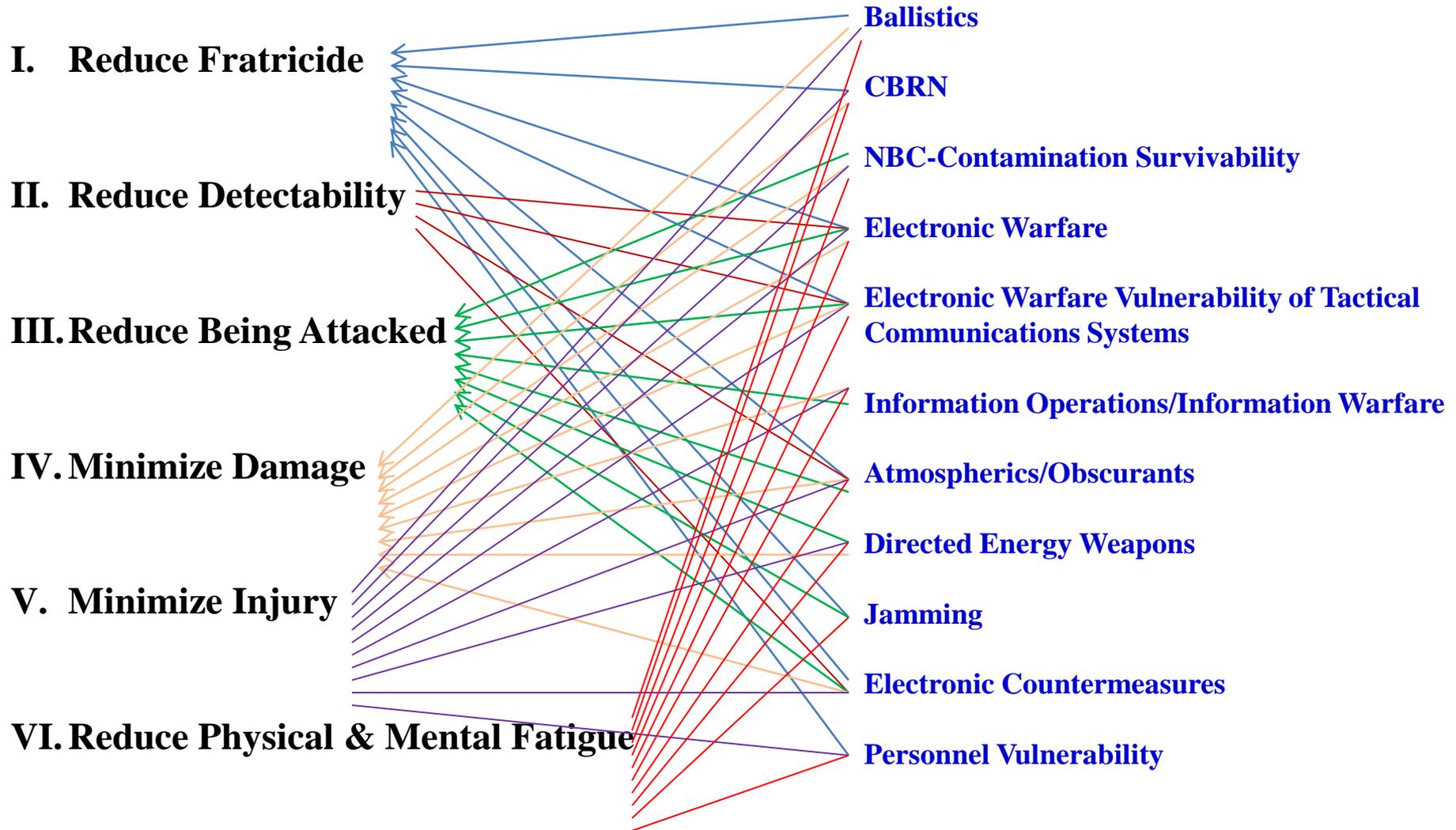
**Countermeasures**

**AFES, Mobility Subsystem, Situational Awareness, Soldier Equipment, Armaments**



[http://upload.wikimedia.org/wikipedia/commons/6/69/XM1206\\_ICV.jpg](http://upload.wikimedia.org/wikipedia/commons/6/69/XM1206_ICV.jpg)

*Conceptual Drawing of  
FCS XM1206 Infantry Carrier Vehicle*



- **Capabilities**
- **Mission**
- **Threats**
- **Protection**
- **Armament**
- **Environment**
- **Design – Base Concept**
- **Live-Fire Test & Evaluation**
- **Egress**

- Initial Capabilities Document
- Security Classification Guide
- Capabilities Design Document
- Capabilities Production Document
- **System Threat Assessment**
- **Design Concepts** – Interior; Exterior; Armor; Active & Passive Protections; Ammo Locations; Weapons; Stowage Plans; Hatches; Seats
- Soldier Uniforms & Equipment that may Protect Against Threats
- Test & Evaluation Master Plan
- Egress & Time to Egress
- Ballistic Test Data
- Toxicity Reports for Materials Used
- Electronic Warfare Test Data
- Signature Management Data
- Information Warfare Developmental Data
- CBRN Data
- Safety, Human Factors Engineering, & Health Hazards Issues

*Vs. Time Availability?*

*e.g. RFI*



Armored Vehicle

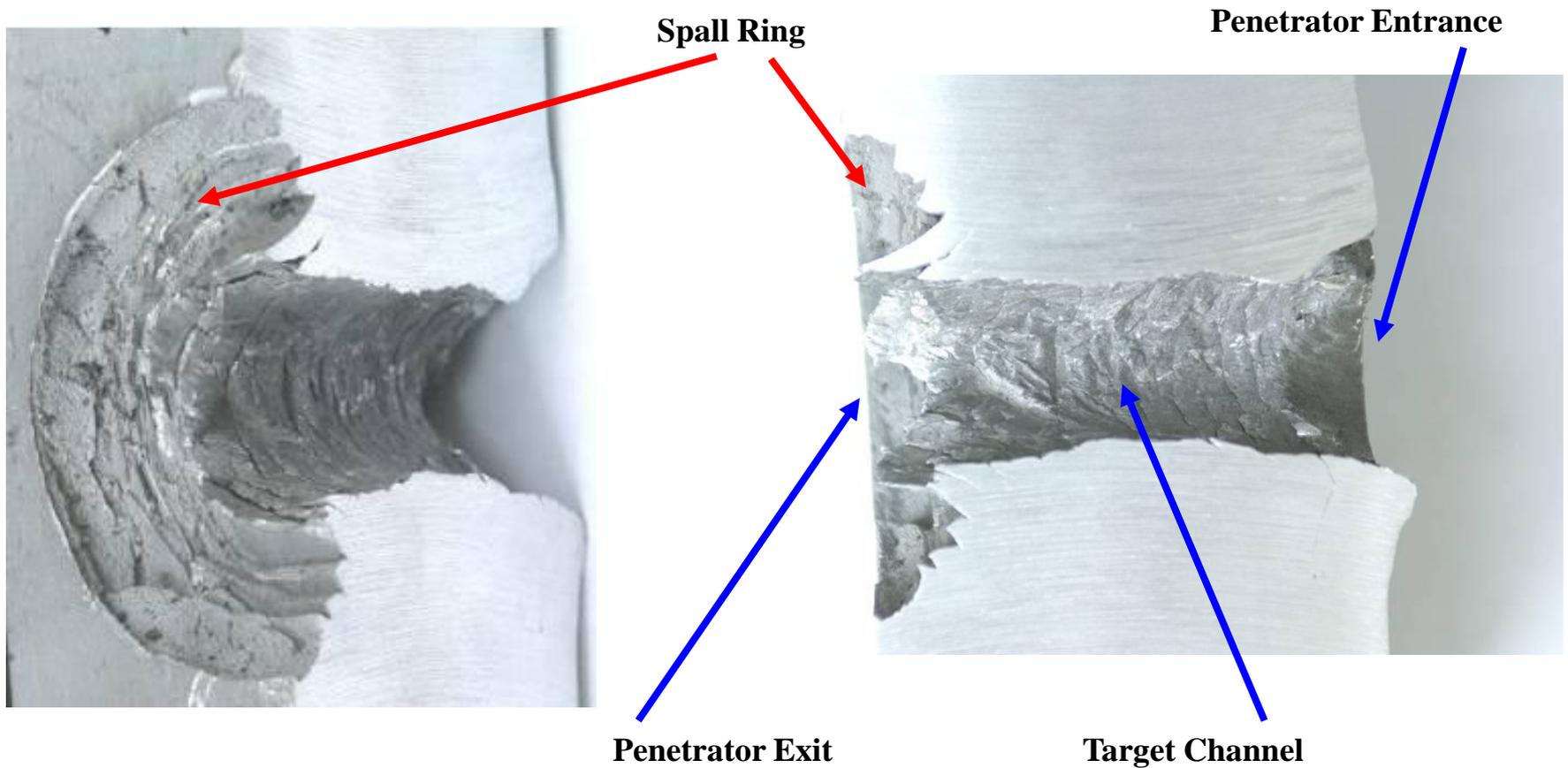
But What Kind of Mission? - Affects the Whole Design

<http://www4.army.mil/OCPA/uploads/large/2006/OCPA-2006-07-31-121530.jpg>

Photo Courtesy of U.S. Army

### TARGET DEBRIS FORMATION

Target – Steel Plate (Rolled Homogeneous Armor)





[http://www.usaasc.info/alt\\_online/printer\\_friendly.cfm?iid=0804](http://www.usaasc.info/alt_online/printer_friendly.cfm?iid=0804)



[http://www.usaasc.info/alt\\_online/printer\\_friendly.cfm?iid=0804](http://www.usaasc.info/alt_online/printer_friendly.cfm?iid=0804)

## Testing & Engineering Analysis for Survivability

**IV.1.a. Does the system adequately protect the crew and squad from direct-fire munitions?**

- (1) Penetration?**
- (2) Blast Overpressure?**
- (3) Spall?**
- (4) Thermal?**
- (5) Acceleration-Deceleration?**
- (6) Gas Toxicity?**



**When Protection Fails - Iraqi Tank 1991**

[http://www.deploymentlink.osd.mil/du\\_library/du\\_ii/figf1.htm](http://www.deploymentlink.osd.mil/du_library/du_ii/figf1.htm)

**IV.1.b. Does the system design minimize the effect of damage through component redundancy, armor, minimizing exposure of critical functions, etc.?**

**IV.1.(k) Does the system adequately protect the crew and squad from direct ... fire munitions?**

### Land Environment:

- **Combat Injury**
- **Combat Damage**
- **Violent Landing - Land: Fire?**
- **Doors Difficult to Open Quickly for Egress?**
- **Egress Through Window?**
- **Wearing Extra Equipment**



<http://www.tradoc.army.mil/pao/viwebpage/TRADOCtrngphotos/ftruckerca/images/RUCKERDAY2053.jpg>

### Water Environment:

- *Combat Injury*
- *Combat Damage*
- *Spatial Disorientation*
- *Operators and passengers experience both physical and psychological stresses of underwater egress situations.*
- *Violent Landing - Sea: Helicopters sink and/or roll inverted upon water entry.*
- *Darkness*
- *Cold Water (~70 degrees F or Lower) Immersion – Causes initial involuntary gasp for breath*
- *Potential Drowning*
- *Potential Hypothermia*
- *Potential Aspiration of Water and subsequent asphyxiation from the rotor downwash of the rescue helicopter.*

## Helicopter Environment:

- Combat Injury
- Combat Damage
- Violent Landing - Land: Fire?
- Doors Difficult to Open Quickly for Egress?
- Egress Through Window?
- Wearing Extra Equipment

## Water Environment:

- Combat Injury
- Combat Damage
- Spatial Disorientation
- Operators and passengers experience both physical and psychological stresses of underwater egress situations.
- Violent Landing - **Sea:** Helicopters sink and/or roll inverted upon water entry.
- Darkness
- Cold Water (77 degrees F or Lower) Immersion – *Causes initial involuntary gasp for breath*
- Egress Through Window/Door?
- Potential Saltwater Ingestion
- Potential Drowning
- Potential Hypothermia
- Potential Aspiration of Water and subsequent Asphyxiation from the Rotor Downwash of the Rescue Helicopter.



Photo: Courtesy U.S. Coast Guard

**V.2. Assess the system's ability to prevent further injury to the Soldier, after being attacked?**

**V.2. d. Can the crew evacuate (escape from) the system in a timely manner?**

**V.3. c. Is rapid evacuation of wounded Soldiers possible?**

**VI.3.a. Does the system protect the Soldier from the following Environmental Stressors?**

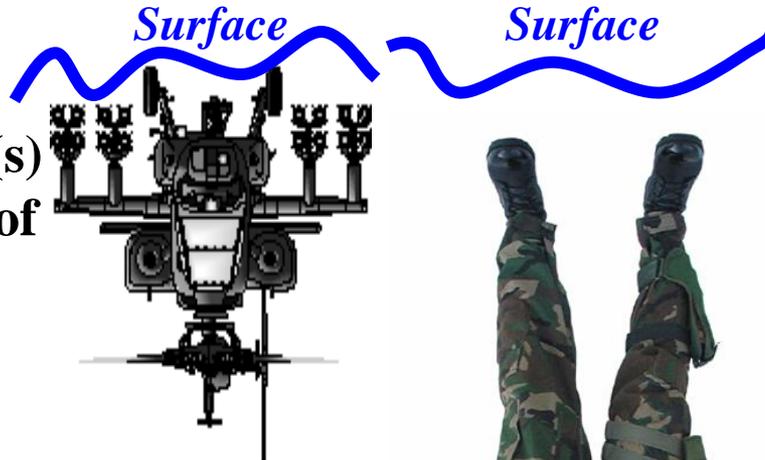
**ii. Cold extremes**

- **Under Water**
- **Water Surface**

>Engine(s) Location(s)  
Causes High Center of Gravity Which Flips Helicopters Upside Down in Bodies of Water

>Problems With:

- Disorientation/Darkness
- NBC Mask Removal
- Disconnecting Straps & Cables
- Activating S.E.A. II Breathing Device
- Opening Exits



**Cockpit Roof**



Photo by Sgt. Bryanna Poulin  
25th Combat Aviation Brigade Public Affairs

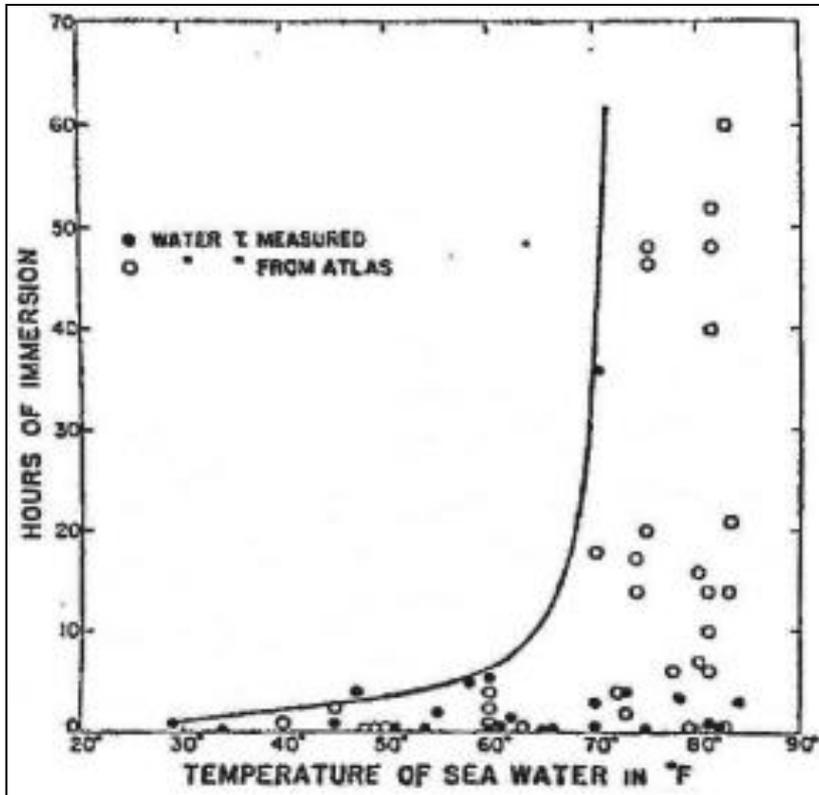


<http://www.tradoc.army.mil/pao/viwebpage/TRADOCtmgphotos/truckerca/images/RUCKERDAY2085.jpg>

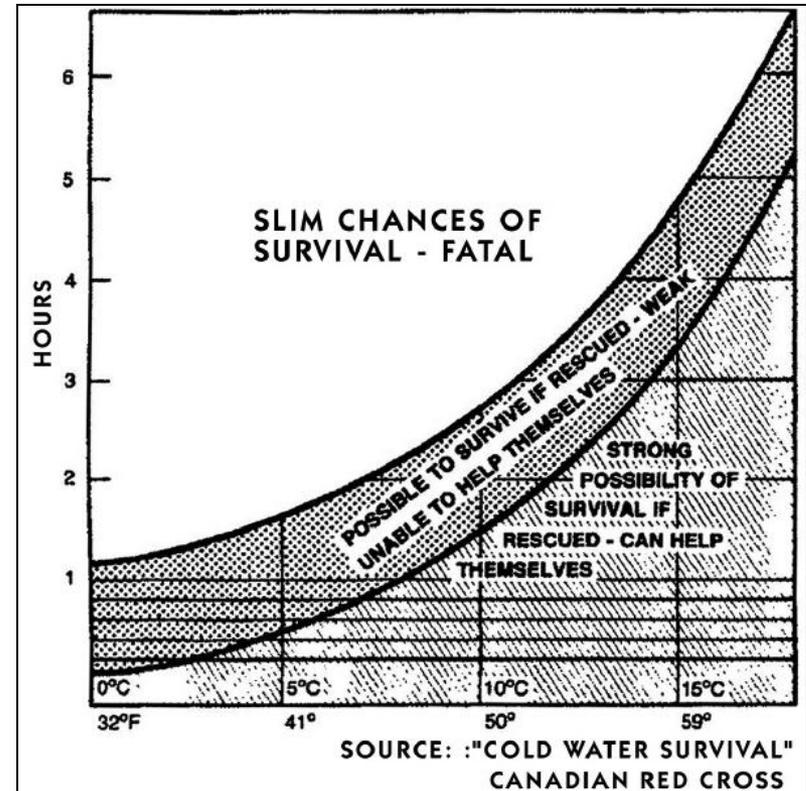
“Both UK and USA statistics indicate that **88%** of controlled (helicopter) ditchings are **successful** but, approximately **50% of survivors die** after safely exiting the aircraft, but **before rescue arrives.**”

<http://www.flight-logistics.com/Ditching.html>

**Heat Loss: 25x Faster for Skin to Water, than for Skin to Air**



**Duration of immersion of shipwreck survivors in ocean waters of diverse temperatures.**



**Cold Water Survival  
(Canadian Red Cross)**

Brooks, C.J., SURVIVAL IN COLD WATER. Survival Systems Limited 2001: Fig 1, Reference 47; Fig 2, Reference 23-26

## SRU-37/P One-Man Life Raft and Container





Picture taken 1 Apr 2003 by CPL Mace M. Gratz; available from the [Defense Visual Information Center](#)



<http://www.nvl.army.mil/thermal.html>

## III.2 Assess the system's ability to actively prevent or deter attack.



Primary &  
Secondary  
Weapons



DoD Photos



<http://www.ttjstk.myrice.com/wqxh/mkw%20tank/merkava12.jpg>

**Design Requirements & Thinking Can Provide Protection During Egress**

- **Is the System Able to Deflect Attack by the Use of Electronic Jamming or Spoofing of a Munition's Sensors?**
- **Is the System Able to Deflect Attack by the Use of Active Ballistic Interdiction to Deflect or Destroy Incoming Munitions?**
- **Has any Microprocessor Code on the System been Protected From the Presence or Insertion of Malicious Code ("Back-Doors," Viruses, etc.)?**
- **Does the System Carry Anything Other Than Ammunition That Could Be Volatile or Toxic in Combat Situations?**



- **Soldier Survivability Encounters a Number of Technical Paths to Pursue**
- **Human Factors, Health Hazards, Safety, & Soldier Survivability Practitioners Can Be Great Sources of Information & Guidance to Each Other**
- **No Single Person Knows Everything, But There Are Many Who Can Help the Assessment**