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AFRL Precision Air Drop

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Air Drop by the Numbers

60,400,000

Pounds dropped in 2010, 99+% CDS ($2.5K/bundle)

<100,000

Pounds dropped in 2010, guided systems ($30+K/bundle)

250

Distance to impact point (in meters) considered an "acceptable" drop

<50

Desired distance to impact point (in meters)

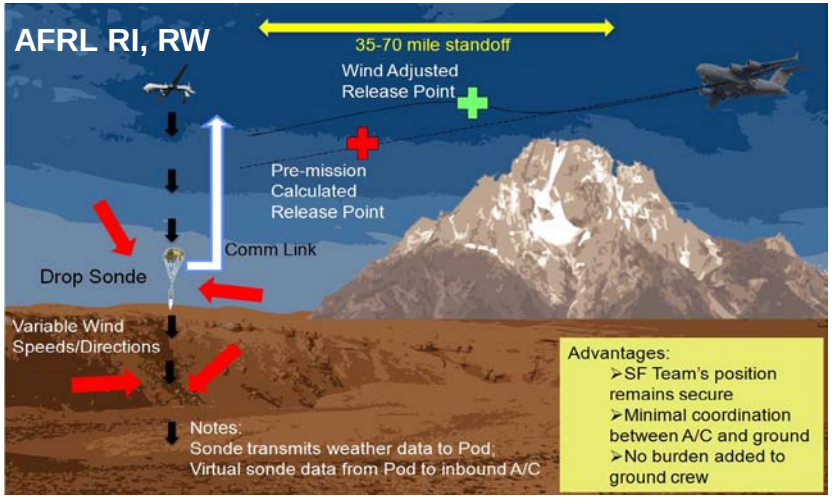
Air Drop Focus Areas

"AMC has a need to provide aerial delivery of a broad range of assets with superb accuracy from extended airdrop offset distances and higher altitudes. Single pass capability solutions should be considered…" Gen Raymond Johns, Commander AMC, 2011

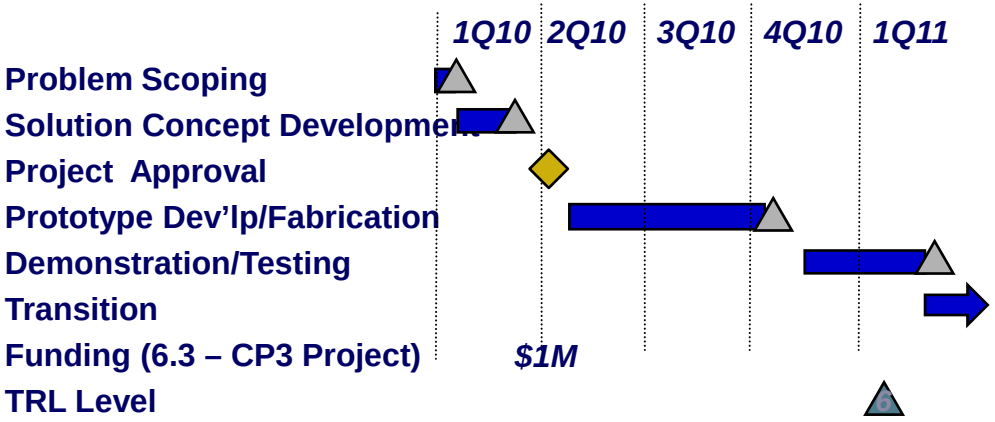
- **"Precision" was the original intent of the AFRL Air Drop focus**
- **AMC's desire was for AFRL to address urgent needs with:**
  - **Critical resupply**
  - **Humanitarian airdrop**
- **AMC's urgent needs shaped the definition of precision**
- **The AFRL Air Drop scope addresses precision as:**
  - **Single pass**
  - **Dispersion predictability**
  - **Situational awareness of bundles**
  - **Impact point accuracy**

SINGLE PASS AIR DROP
&
PRECISION AIR DROP

Single Pass Airdrop (SPAiD)



Technology InvestmentSchedule (FY10)



Description

Rapidly find technical solution for AFCENT UON to eliminate need for 2 passes over drop zones during high altitude airdrop ops

Technology

- AFRL proposed UAV-based weather drop sonde-release solution; Ready to demo in 2Q11
- Integrate into C-17, C-130 Joint Precision Air Drop System Mission Planning (JPADS-MP) Computer

Benefits to the War Fighter

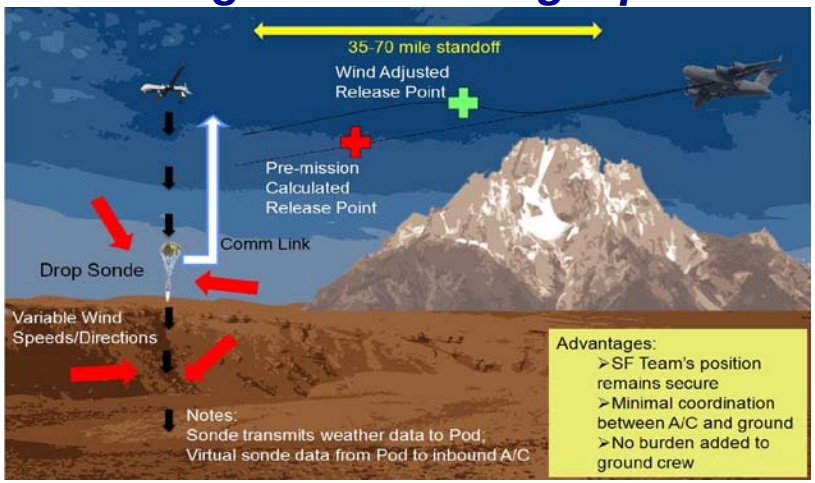
- Eliminates multiple aircraft passes over drop zone
  - Reduces potential for enemy fire
  - Prevents tip-off of drop event
- Allows precision delivery of packages with lower-cost Improved Container Delivery System (ICDS)
- Simplifies mission profiles and time aloft for air delivery missions
- Solves AFCENT UON/Requirement

Single Pass Air Drop (SPAiD)

FY10 Accomplishments

- **Objective:** Collect current, drop zone (DZ) weather data, which will enable mobility aircraft to perform <u>accurate</u> air drop to the target DZ in a *single pass*

- **Challenges**
  - -Coordination Efforts
    - AMC/ AFMC/ ACC/ AFCENT
    - In-theater
  - -Reduce drop sonde size; increase reception range
  - -Pod attachment to RPA (Predator)
  - -Pod design/flight worthiness approval
  - -Surrogate flight approval/Pod components flight test
  - -UON priority--compressed schedule
  - -RPA (Predator) asset availability
    - We need a Predator for 1-week test in CONUS

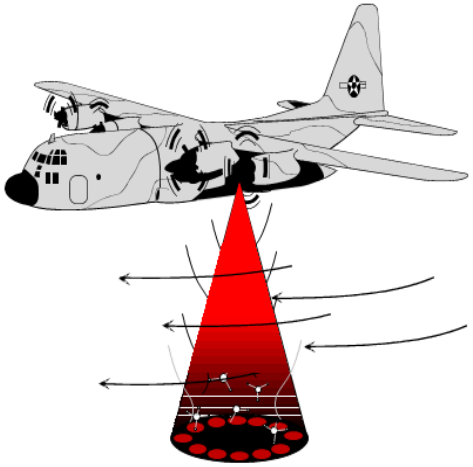


- **Accomplishments**
  - *-Smaller drop sonde – 87% reduction in weight*
  - -Predator availability in-theater; support from 62 ERS (Kandahar)
  - *-Data Storage/Forwarding*
    - *increased reception from 6nm to 100nm*
  - *-Pod slide-on attachment to Hellfire rail system*
  - *-Successful Pod components flight test, Dec 2010*
  - *-AMC/AFCENT G.O. level coordination and endorsement*
  - *-Transition to part of FCC from CP-3*

M34 Dummy Hellfire Interim pod
- *~99 lbs*
- *Quick Seek Eagle Approval*

•Lightweight TMS pod
- *•~15 lbs*
- *•Transition 3Q11*

Precision Airdrop



Description

Develop technologies that improve the accuracy and lowers the cost of Container Delivery System (CDS), humanitarian, and guided airdrops.

Technology Challenges

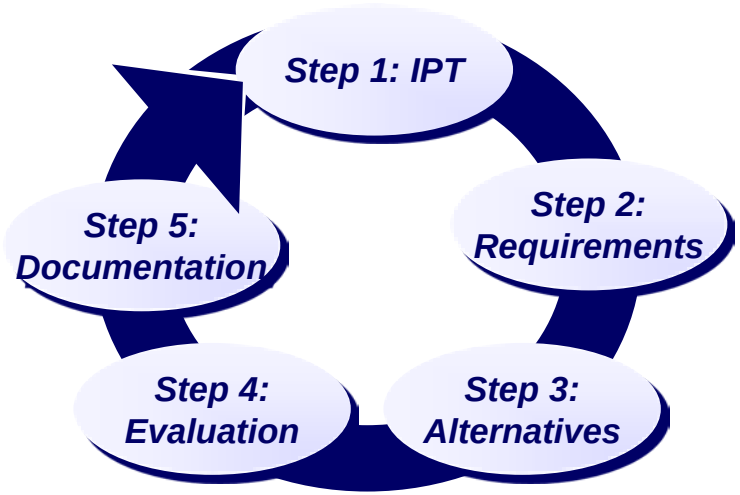
- Real-time wind sensing
- Automated green light release technology integration
- Error budget analyses and improved modeling approaches
- Low cost highly accurate guided drop systems
- Humanitarian relief delivery concepts

Benefits to Warfighter

- Improves accuracy of CDS drops
- Lowers the cost of precision drops
- Lowers the risk of unintended consequences
- Improves pre/post drop SA
- Improves bundle SA

AFRL REQUIREMENTS DERIVATION

Systems Engineering (SE) Process



- Develop Requirements and Metrics
  - Solicit Input from All Stakeholders
  - Define Measurands, Desirability Functions, and Relative Importance
  - Repeat as Knowledge Advances
- Generate Technology Alternatives and Conceptual Designs
- Perform Value Analysis to Evaluate Alternatives
  - Evaluate Alternatives against Requirements
  - Compute Desirability and Risk for Each Concept
  - Explore Trade Space
  - Generate or Refine Alternative Approaches
  - Select Most Promising Approach
- Deliver Results: Recommend Alternatives

Desirements Development

Des #	Desirement Name	Units	Obj	Risk Limit	Desirement Description	Assumption, How Tested or Other Clarification	Objective Rationale	Rationale for d-Limit	Priority	Wt
Category: A. Performance										
P01	Impact									5
P02	Predict Disper									5
P03	Accura Execut									5
P04	Predict Event									5
P05	Platfor					compatible with aircraft variant; 1 = aircraft				5

P01: Impact Point Accuracy

Critical Resupply

Description: Accuracy of impact point, measured as the difference between planned and actual (x,y,z) location of center of the dispersion pattern on impact, based on a 3,000 ft AGL drop.

Clarification: This is not a CEP number; it is more a 90% probability number. The expectation for greater accuracy increases at lower altitude.

Unit of Measure: meters

Priority: Very High

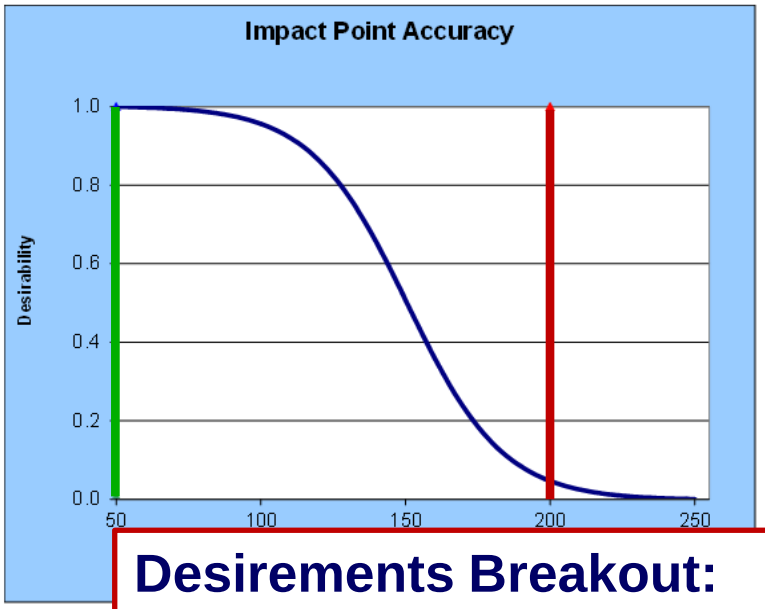
Weight: 5

Objective: 50

***Risk Limit*:** 200

Objective Rationale: 50 m 90% of the time is the objective requirement from the JPADS CDD.

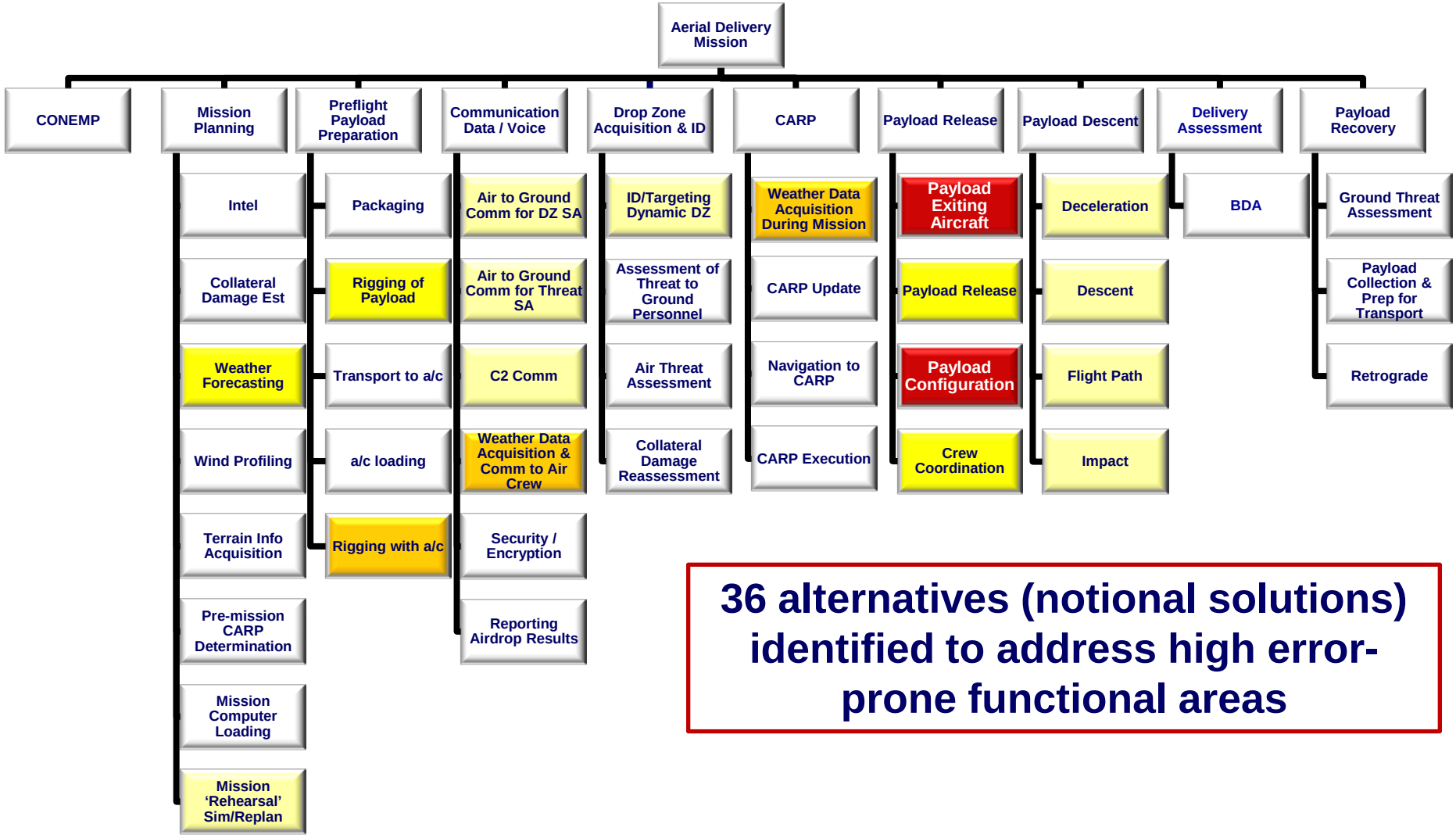
***Risk Limit* Rationale:** Current level of performance. Must improve upon this.



Desirements Breakout:

- Performance – 20
- Human Factors – 7
- Cost – 5
- Security - 2

Functional Work Breakdown Structure



36 alternatives (notional solutions) identified to address high error-prone functional areas

Alternatives Analysis & Tradeoffs
Tradespace Refinement

Des #	Desirement Name	Units	Current		I-Skid		I-SkidAdv		I-Dun		I-DunAdv		I-Release		Active Shaping		ForceEx		Air Bags	
			Expecte	Wor/Bst	Expecte	Wor/Bst	Expecte	Wor/Bst	Expecte	Wor/Bst	Expecte	Wor/Bst	Expecte	Wor/Bst	Expecte	Wor/Bst	Expecte	Wor/Bst	Expecte	Wor/Bst
Category: A. Performance																				
P01	Impact Point Accuracy	meters	400	800	325	725	300	675	400	800	400	800	250	650	175	575	175	575	400	800
P02	Predictability of Dispersion Pattern	meters	200	400	162.5	362.5	150	337.5	200	400	200	400	125	325	87.5	287.5	87.5	287.5	200	400
P03	Accuracy of CARP Execution	yards	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200	100	200
P04	Predictability in the Event of Malfunction	Confidence	90														95		90	
P05	Platform Agnostic	Scale: 1–5	1														1		5	
P06	Likelihood of Avoiding Collateral Damage	Probability	90														95		90	
P07	Communication Capability	Scale: 1–5	2	1													2	1	2	1
P08	Agility / Flexibility	Minutes	20		20		20		20		20		20		20		20		20	
P09c	Number of Passes	Count	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
P09h	Load Deliverable in a Single Pass	%	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
P10	Survivability of the Load	Confidence	90		90		90		93		95		90		95		90		97	
P11	Bundle-Awareness Capability	Scale: 1–5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
P13	Mass Capability (Max)	lb	2200	2200	10000	15000	10000	15000	10000	15000	10000	15000	10000	15000	10000	15000	10000	15000	2200	2200

36 alternatives were given a sanity check and scored against the desirements by time frame…0-5 yrs and 5+yrs

Findings and Way Forward

- The SE process educated AFRL on air drop and the associated trouble spots
- The process became less effective with the scoring of the alternatives against the desirements
  - Lack of real data prevented an understanding of how the alternative would affect the air drop outcome
  - There was no robust error budget model or analyses available
  - Outcome set the stage for a multi-phase AFRL approach
- The AFRL Air Drop way-forward is evolving
- AFRL is proposing a Phase I discovery period where AFRL/Army Natick/AMC work to collect data from air drop flights

Way Forward – cont'd

- **AFRL has teams addressing:**
  - On-board WX sensing integrated with sniper pod technology
  - Automated Green Light Release
  - Payload Exit/Release Improvement
  - Air Drop for Humanitarian Relief
  - Low Cost Guided Air Drop
- **Each team lead has emphasized the need to capture:**
  - Aircraft dynamics at release point
  - Bundle dynamics at release point and during descent
  - Weather situation and affects
  - Parachute specifics (type, material, extraction/opening times)
- **A complete picture of the problem is needed to drive our S&T efforts to the highest payoff solution**

Summary

- AFRL is fully engaged in the air drop problem
- The problem is challenging and needs further deep-dive understanding
- AFRL is planning on FYDP solutions that can be transitioned to AMC to address CDS and humanitarian drops
- AFRL is also working plans with the Army to make guided air drop systems more attractive
- The AFRL S&T process needs to be thorough to yield high payoff solutions