

Aeronautical Systems Center

Birthplace, Home and Future of Aerospace



Low VOC, Plural Component Spray (PCS) Coatings Program

7 May 2009

Thomas A. Ferrill
SAIC – Dayton, OH
(937) 431 - 2330
thomas.a.ferrill@saic.com

Roddy Keish
ASC/ENVV – WPAFB, OH
(937) 255 - 3541
rodody.keish@wpafb.af.mil

U.S. AIR FORCE

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE 07 MAY 2009		2. REPORT TYPE		3. DATES COVERED 00-00-2009 to 00-00-2009	
4. TITLE AND SUBTITLE Low VOC, Plural Component Spray (PCS) Coatings Program				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Science Applications International Corp,5100 Springfield Street,Dayton ,OH,45431				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES Presented at the NDIA Environment, Energy Security & Sustainability (E2S2) Symposium & Exhibition held 4-7 May 2009 in Denver, CO.					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 33	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



U.S. AIR FORCE

Presentation Overview



Rapidly delivering war-winning capability

- **Program Organization**
- **Issues**
- **PCS Program Objectives**
- **Technical Approach**
- **Technical Progress**



U.S. AIR FORCE



Rapidly delivering war-winning capability

Program Organization

Issues

PCS Program Objectives

Technical Approach

Technical Progress

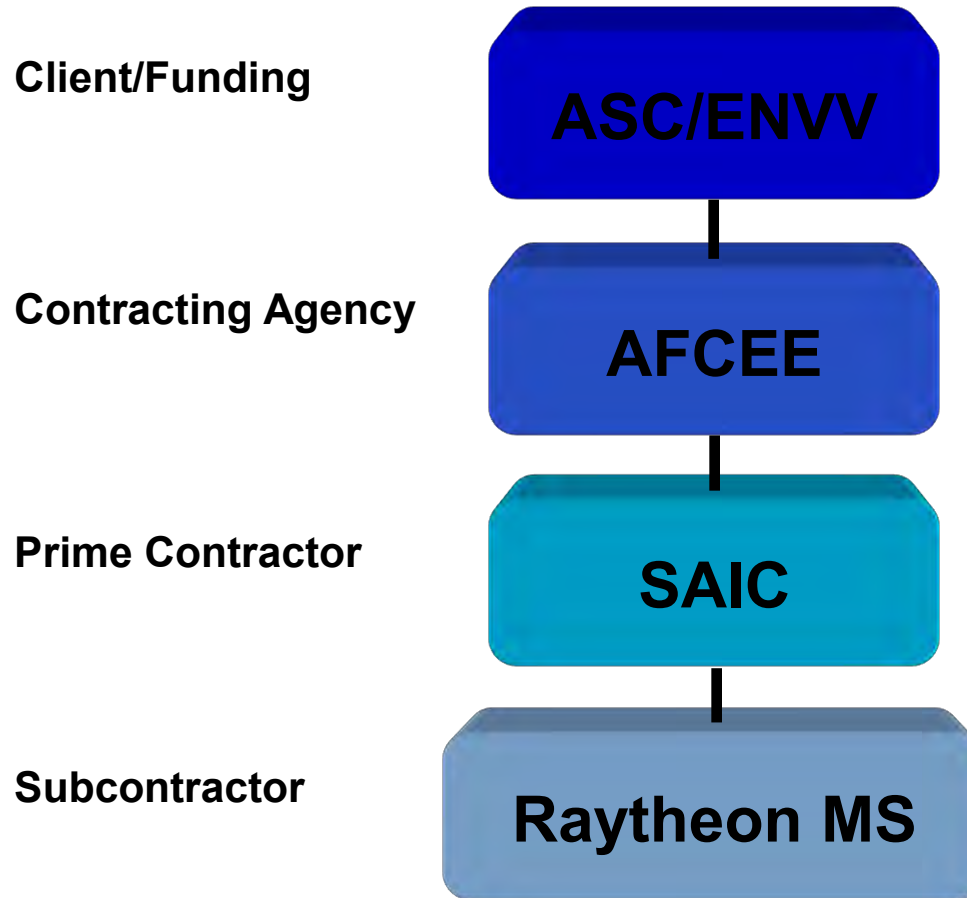


U.S. AIR FORCE

Program Organization



Rapidly delivering war-winning capability





U.S. AIR FORCE



Rapidly delivering war-winning capability

Program Organization **Issues**

PCS Program Objectives
Technical Approach
Technical Progress

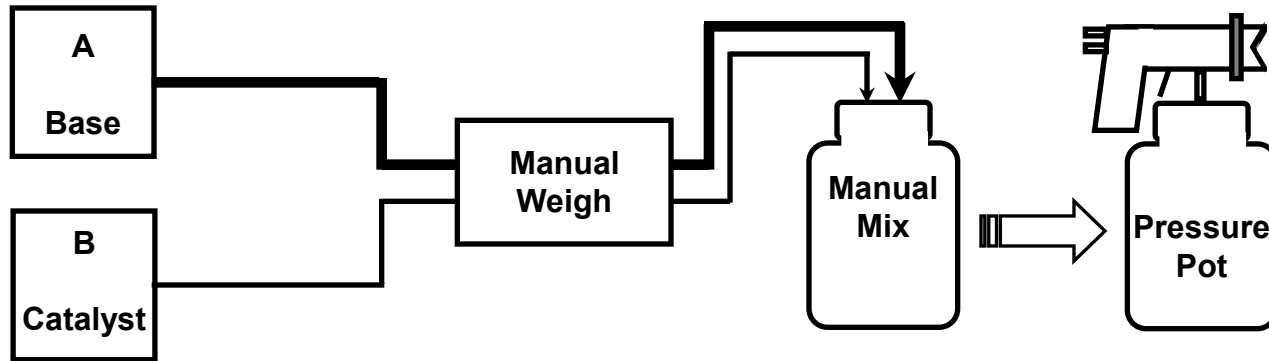


Batch Application Method



Rapidly delivering war-winning capability

Ad-Mixed Batch



Drawbacks

- Manual proportioning
- Not quick cure compatible
- Pot-life limitations with ad-mixed material
- Large volumes of paint and solvent waste



Aerospace Coating Issues



Rapidly delivering war-winning capability

- **Time and labor intensive**
 - Large required coating thickness
 - Wet mils per pass limitations
 - Long dwell time between passes
 - Time to topcoat limited by slow cure
- **High VOC content**
 - Above targeted VOC goal
 - Costly permitting, monitoring, and controlling



U.S. AIR FORCE



Environmental Impact

Rapidly delivering war-winning capability



- **VOC flash-off contributes to overall facility allotment**
- **Cleaning generates large volumes of hazardous waste**
- **Generated waste must be disposed of**
- **VOC monitoring and health screening burden**





U.S. AIR FORCE



Rapidly delivering war-winning capability

Program Organization
Issues

PCS Program Objectives

Technical Approach
Technical Progress



U.S. AIR FORCE

Program Objectives



Rapidly delivering war-winning capability

- **Reduce VOC content**
 - Objective: 0 g/L; Threshold: 150 g/L
- **Reduce overall production flow time**
 - Increased build rate
 - Decreased cure time
- **Reduce waste generation**
 - Unused coating
 - Cleaning solvent
- **Support follow-on efforts**
 - Collect remaining cost benefit data
 - Prepare for full-scale validation



U.S. AIR FORCE

Coating Properties



Rapidly delivering war-winning capability

Performance Measure	Objective
VOC Content (g/L)	0
Cure Time (hr)	66% of Baseline
Build Rate (wet mils/pass)	≥ Baseline
Time Between Passes (min)	≤ Baseline
Coating Waste Generated (gal)	50% of Baseline
Cleaning Solvent Used (gal)	50% of Baseline
Occupational Health Risk	No Increased Risk



U.S. AIR FORCE

Expected Program Benefits



Rapidly delivering war-winning capability

Benefit	Result	Impact
Reduced VOC content	Reduced facility VOC emissions	<ul style="list-style-type: none"> • Decreased permitting costs • Decreased monitoring costs • Decreased controlling costs
Plural Component Design	Decreased coating and solvent waste	<ul style="list-style-type: none"> • Decreased material usage • Decreased material cost • Decreased labor hours for equipment clean-up
	Decreased hazardous waste generation	<ul style="list-style-type: none"> • Decreased hazardous waste storage and disposal costs • Decreased health screening costs
Increased build rate	Decreased application time	<ul style="list-style-type: none"> • Decreased application labor hours
Improved cure package	Decreased time for full cure	<ul style="list-style-type: none"> • Decreased production flow time



U.S. AIR FORCE



Rapidly delivering war-winning capability

Program Organization
Issues
PCS Program Objectives
Technical Approach
Technical Progress



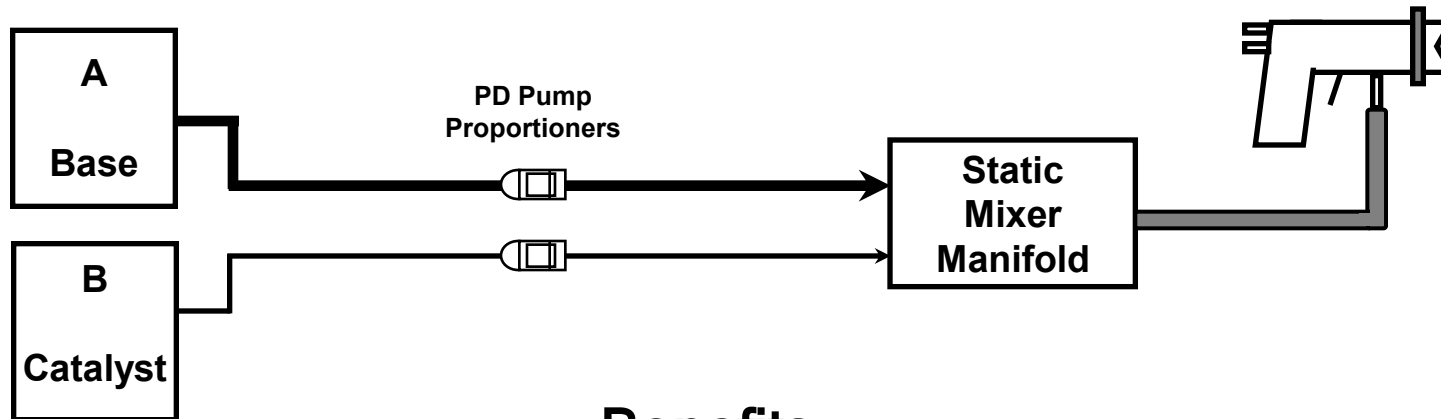
U.S. AIR FORCE

Continuous Application Method



Rapidly delivering war-winning capability

Plural Component Spray



Benefits

- Automated proportioning
- Precision mixing
- Utilizes HVLP spray guns
- Accommodates quick cure coating
- Minimizes waste material
- Minimizes cleanup waste and time

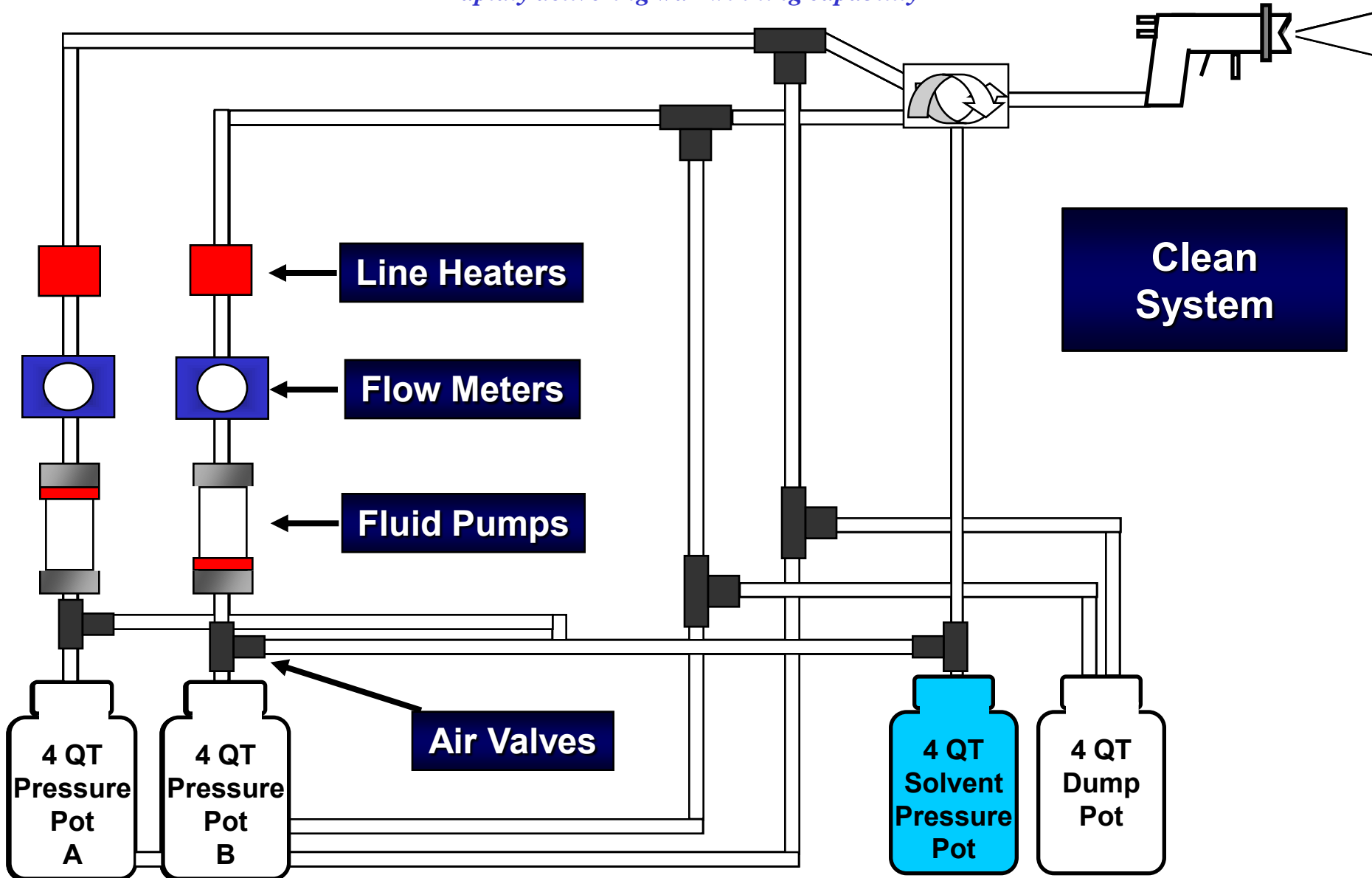


U.S. AIR FORCE



Detailed PCS Schematic

Rapidly delivering war-winning capability





Methodology – Phase I

Rapidly delivering war-winning capability

- Candidate Evaluation
- Cost-Benefit Data
- Future Dem/Val

Phase II Activities

Performance Testing

- Comparison to baseline material
- Full properties testing & reformulation (*if needed*)
- Final candidate(s) recommendations (Maximum of 2)

Screening Testing

- Comparison to baseline material
- Critical properties testing & reformulation (*if needed*)

Verification and Down-Selection

- Verification of vendor claims
- Limited testing & reformulation (*if needed*)
- Selection of screening candidates (Maximum of 5)

Material Selection and Formulation

- Industry survey of vendor products
- Evaluation against Raytheon criteria
- Selection of initial candidates

Test Plan Development

- Outline of individual tests
- Candidate performance criteria
- Identify stakeholder concerns



Methodology – Phase II



Rapidly delivering war-winning capability

- Candidate Qualification
- Cost-Benefit Data
- Documentation

Phase III Activities

Production Acceptance Testing

- Production size batches
- Verification of product consistency
- Critical properties testing

Full-Scale Demonstration

- Comparison to baseline material
- Full-scale engineering structure
- Application & usage properties

Demonstration Plan Development

- Programmatic document for Phases II & III
- Coordination of project stakeholders
- Promote successful technology transition

Phase I Activities



Methodology – Phase III

Rapidly delivering war-winning capability

- Documentation
- Implementation

Transition Activities

- Present project results to engineering change boards
- Acquire government and contractor approvals
- Include PCS technology within all relevant QPLs and TOs

Cost & Performance Report

- Technology overview
- Cost and performance assessments
- Identification of implementation issues

Final Report

- Project overview
- Summary of test results
- Support documents

Full-Scale Validation

- Production spray equipment
- Optimization of critical application parameters
- Comparison to baseline material

Phase II Activities



Demonstration Plan Development



Rapidly delivering war-winning capability

- **Consideration of**
 - Performance & application parameters
 - Barriers to implementation
 - Initial cost-benefit analysis
- **Guidance**
 - Full-scale demonstration (Phase II)
 - Production acceptance testing (Phases II & III)
 - Full-scale validation (Phase III)



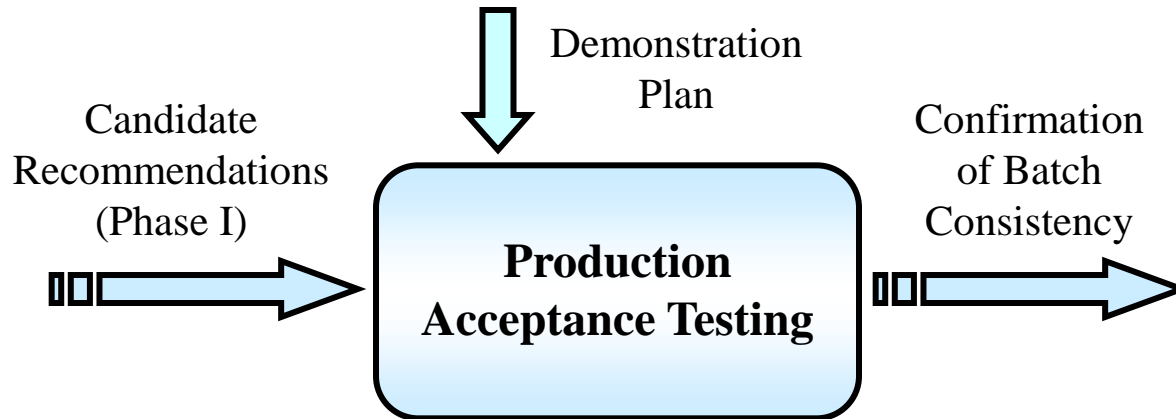


Production Acceptance Testing



Rapidly delivering war-winning capability

- **Production Consistency**
 - Between batches
 - Within batches
- **Phase II**
 - Two production-sized batches
 - Two PCS candidates

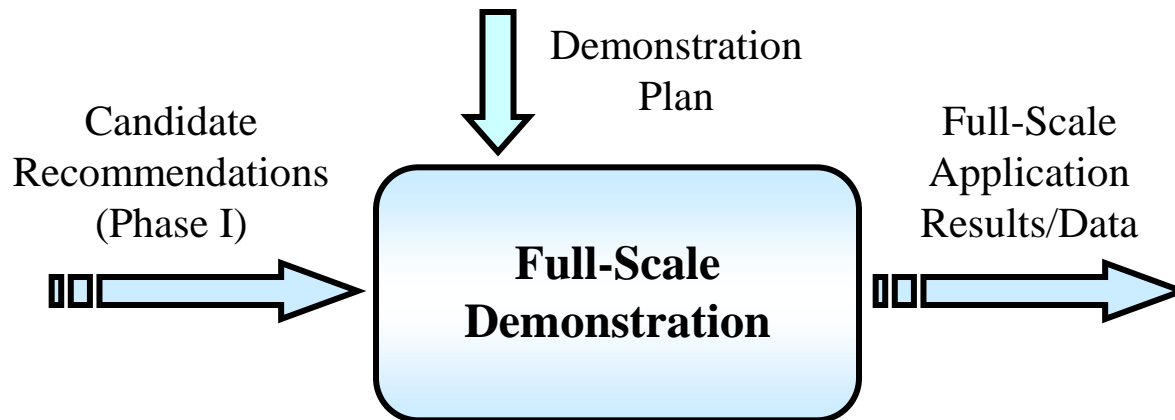




Full-Scale Demonstration

Rapidly delivering war-winning capability

- **Demonstration of application properties**
 - Spray-up engineering prototype/structure
 - Two PCS candidates & baseline
- **Compare**
 - Application performance
 - Cost metrics
 - Spray data/results



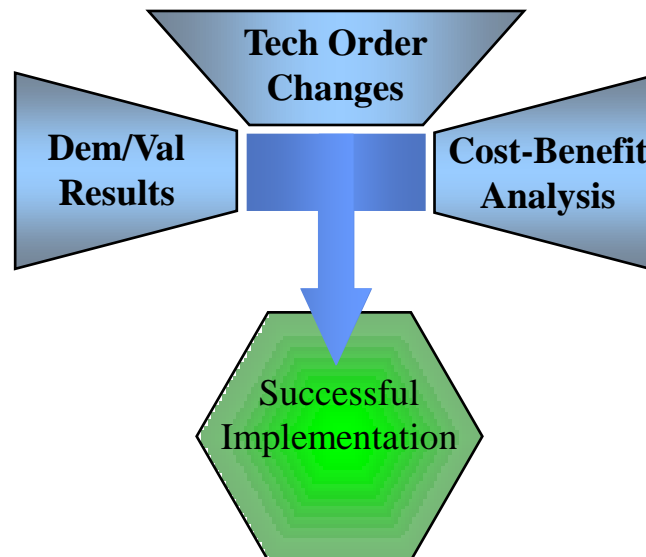


Follow-On Efforts



Rapidly delivering war-winning capability

- **Plan Full-Scale Validation**
 - Suggested Raytheon facility
 - Identify window of opportunity
- **Complete Data Collection**
 - Collect facility baseline & PCS cost data
 - Identify technology transition timeframe



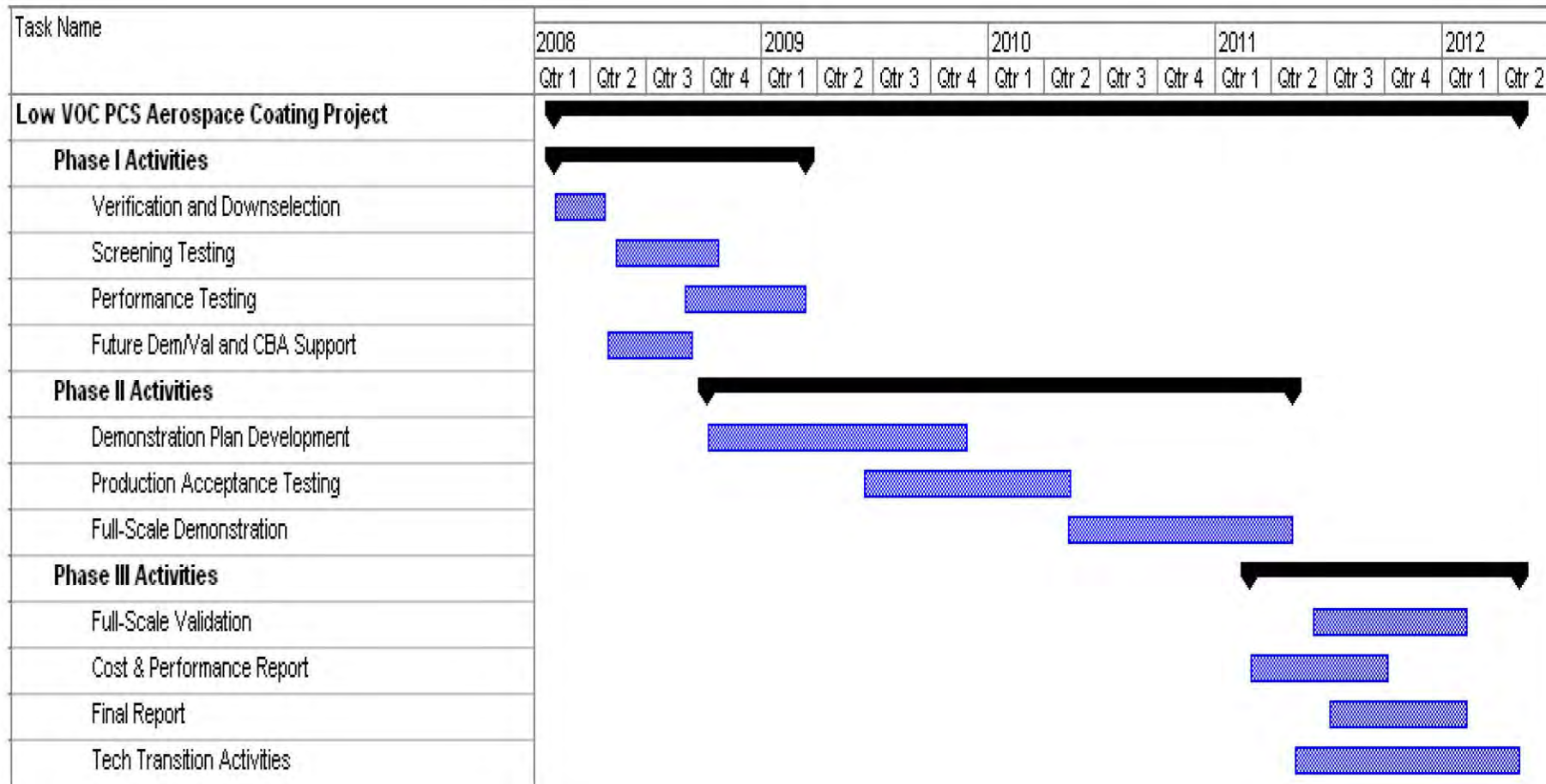


U.S. AIR FORCE

Task Plan



Rapidly delivering war-winning capability





U.S. AIR FORCE



Rapidly delivering war-winning capability

Program Organization
Issues
PCS Program Objectives
Technical Approach
Technical Progress

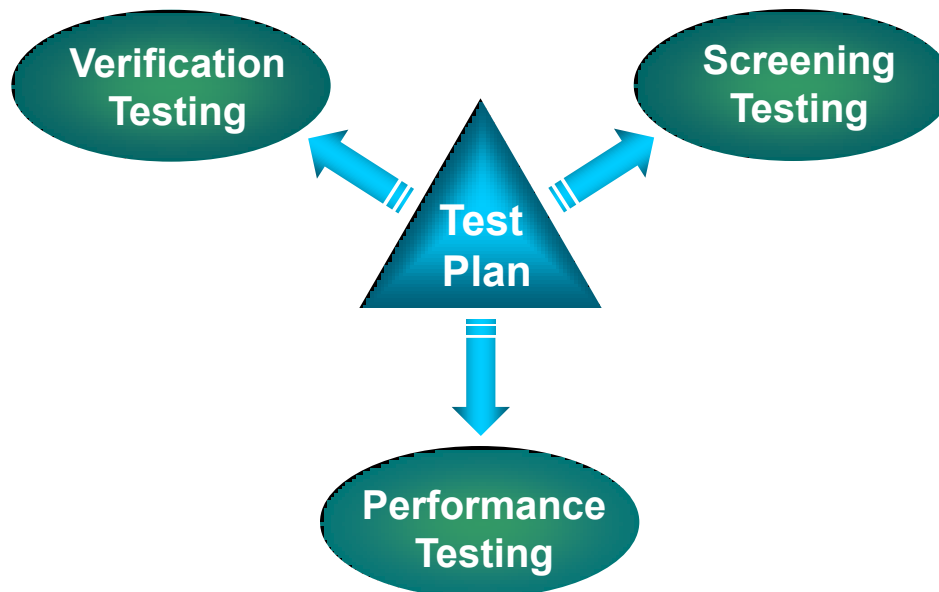


Test Plan Development



Rapidly delivering war-winning capability

- **Test Plan – Delivered**
 - Outlines all material testing by phase
 - Describes test procedures
 - Identifies associated pass/fail criteria
 - Documents test and control panel quantities





U.S. AIR FORCE

Material Selection and Formulation



Rapidly delivering war-winning capability

- **MS&F – Completed**
 - Vendors submitted candidate coatings
 - Candidates identified
 - Transitioned to next stage





U.S. AIR FORCE

Verification and Down-Selection



Rapidly delivering war-winning capability

- **V&D – Completed**
 - **Candidate materials procured**
 - **Spray evaluation completed**
 - **Limited testing accomplished**
 - **No product reformulations**
 - **All candidates demonstrated potential**
 - **Transitioned to next stage**





Screening & Performance Testing



Rapidly delivering war-winning capability

- **S&PT – Completed**
 - Candidate materials procured
 - Robust performance testing accomplished
 - No product reformulations
 - Recent down-selection decision
 - Two candidates move onto full-scale Phase II activities



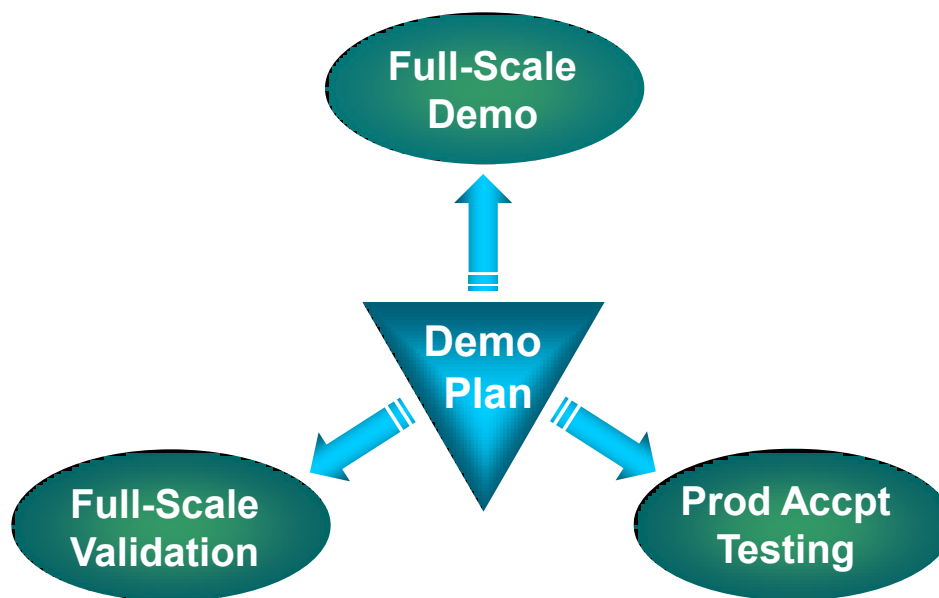


Demo Plan Development



Rapidly delivering war-winning capability

- **Demonstration Plan – Draft Development**
 - Populating document with required information
 - Gathering inputs from stakeholders
 - Demo Plan approval projected for Q4 2009





U.S. AIR FORCE



Summary

Rapidly delivering war-winning capability

- **Current Aerospace Coatings Application Methods**
 - Batch mixed
 - Continuous (plural component spray)
- **PCS Program Goals**
 - Identify promising candidates
 - Confirm full-scale applicability
 - Qualify & implement PCS alternative
- **Expected Environmental Benefits of PCS Technology**
 - Reduced VOC content
 - Reduced overall application and cure times
 - Reduced hazardous waste generation
 - Reduced labor hours for clean-up
- **Status**
 - Candidate material test matrix identified
 - Candidate performance testing completed
 - Down-selection decision occurred (Phase I close-out)
 - Phase II activities beginning



U.S. AIR FORCE



Rapidly delivering war-winning capability

Questions?



U.S. AIR FORCE



References

Rapidly delivering war-winning capability

- Gempis, MSgt V. (2000). *Air Force Link - Photos*. Retrieved February 7, 2007, from <http://www.af.mil/shared/media/photodb/photos/001115-F-1740G-006.jpg>
- Greenway Research Lab Capabilities (2006). *Product Formulation Montage*. Retrieved February 16, 2007, from rocco altobelli companies Web site: http://www.roccoaltobelli.com/greenway/img/content/photo_pages.jpg
- Perkins, A1C F. J. (2004). *Air Force Link - Photos*. Retrieved February 7, 2007, from <http://www.af.mil/shared/media/photodb/photos/040415-F-9072P-003.jpg>
- Q-Panel Brand Test Substrates (2007). *Q-Panel Size Assortment*. Retrieved February 16, 2007, from Q-Lab Corporation Web site: <http://www.q-panel.com/UserFiles/Image/Q-Panel-Vaious-Size-Panel-Towers.jpg>
- Instron Materials Testing Solutions (2009). *Sandwich Flatwise Tension Fixture with 2 Inch Square Bond Faces*. Retrieved March 3, 2009, from Instron Web site: http://www.instron.us/walacc_catalog/detail.aspx?aid=3551&ref=http://images.google.com/imgres
- TA Instruments: Dynamic Mechanical Analysis (2009). *TA Instruments Product Brochure*. Retrieved March 3, 2009, from TA Instruments Web site: <http://www.tainstruments.com/pdf/brochure/dma.pdf>