Flight Test Success through Effective Mission Assurance Strategy

19 November 2008

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Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
01 NOV 2008	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Flight Test Success through Effective Mission Assurance Strategy	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) **MDA/QS Deputy Director - RSA**	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
See also ADM202644. AIAA Missile Sciences Conference Held in Monterey, California on November 18-20, 2008, The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**12**	

The "Definition"

FAILURE: OMISSION OF OCCURRENCE OR PERFORMANCE; A FAILING TO PERFORM A DUTY OR EXPECTED ACTION

History of THAAD Flight Test Failures

THAAD PDRR Flight Test Failures

Flight	Date	Failure	Design Issue(s)	Root Cause
FT-2	01-Aug-1995	Flare deploy failure	No clearance, not inspectable, poor teflon choice)	Damaged at installation
FT-3	13-Oct-1995	FPA edges overran CPU	Software overrun condition	No HWIL test
FT-4	13-Dec-1995	Radar error s/w mistake	SW sign flaw	No ground test of SW
FT-5	22-Mar-1996	Failed KV separation	Cramped assy, used beyond design limits	Pinched or nicked lanyard
FT-6	15-Jul-1996	FPA half blinded	No failsafe software	FOD
FT-7	06-Mar-1997	No DACS response	Poor potting compound choice	FOD
FT-8	12-May-1998	TVA short	Exposed hot pins	FOD
FT-9	29-Mar-1999	DACS nozzle break	Poor material properties, excessive shocks	Ground handling damage

Gen. Welch Team Findings

THAAD PD&RR Findings	THAAD Program Changes
Intense time pressure - rush to failure	• Phased-acquisition strategy during Development relieves schedule risks/pressures • Planned 49 months to first Development flight (compared to 24 months in PDRR) • Event driven program resulted in first flight during month 63
Initial design and fabrication were not subjected to adequate discipline and quality control	• Concurrent Engineering involvement in early IPTs (design-in: inspectability, testability, and requirement reliability) • Followed disciplined incremental design review process chaired by Program Chief Engs • Increased subcontractor management and on-site presence
Inadequate ground checkout discipline, and pressures to move on to next step	• Full qualification of components and sub-assemblies, comprehensive ground tests, and sequential testing with time to fix major problems prior to next test (during Dev) • "Test-as-you-fly" testability designed-in during Development
Changing configurations and goals between flight tests	• Minimal hardware changes between flights • Software upgrades limited and strategically planned
Fundamental concerns regarding leadership and management	• Senior management team from end of PDRR remains in place • Contractor Missile lead position elevated to "VP" level
Basic philosophy change needed	• "Mission Success" and continuous improvement of all processes through metrics • Program philosophy placed technical over cost
Little evidence of systems engineering process and talent	• Stable System Engineering Team through design reviews and first six flights • Program lead configuration change board • Concurrent engineering approach implemented
Software management and development process not disciplined	• Disciplined Engineering Review Board, Software Review Board, Program Change Control Board process in place • All software ground tested in System Integration Laboratory before flight
Inadequate product assurance program	• Empowered the THAAD Quality organization (Contractor QA reports directly to Contractor President. Program QA reports directly to THAAD PM) • Approved QA plans in-place and levied on subcontractors • FRACAS system implemented with subcontractors • Quality and Mission Success leaders have a full veto vote on all mission success issues

Program success is a result of the implemented corrective actions and continuous improvement process.

History of THAAD Flight Test Successes

THAAD PDRR Flight Test Successes

Flight	Date	Demonstrated Objective	Video
FT-10	10-Jun-1999	High lofted trajectory unitary target intercept	Video
FT-11	02-Aug-1999	High lofted trajectory separating target intercept	

History of THAAD Flight Test Successes

THAAD WSMR Flight Test Successes

Flight	Date	Demonstrated Objective	Video
FTT-01	22-Nov-2005	Interceptor Controlled Flight Test – demonstrated kill vehicle control	
FTT-02	11-May-2006	Integrated System Test – radar, launcher, TFCC and Interceptor closed loop functionality against a simulated virtual unitary target	
FTT-03	12-Jul-2006	Integrated Element Seeker Characterization Test – intercept of a high-endo unitary target	Video
FTT-04	13-Sep-2006	"No Test" due to target failure	
FTT-05	26-Jun-2007	Interceptor Controlled Flight Test – demonstrated low-endo, high dynamic and aero heating control	

History of THAAD Flight Test Successes

THAAD PMRF Flight Test Successes

Flight	Date	Demonstrated Objective	Video
FTT-06	26-Jan-2007	High Endo Intercept of a Unitary Target	Video
FTT-07	05-Apr-2007	Mid Endo Intercept of a Unitary Target	Video
FTT-08	26-Oct-2007	Exo Intercept of a Unitary Target	Video
FTT-09	25-Jun-2008	Low Endo Intercept of a Separating Target	Video
FTT-10	15-Sep-2008	Exo Intercept of a Separating Target	

Continued Focus On Mission Assurance

- **Technical Requirements on Contract**
- **Supplier Management**
- **Accountability**
- **Mission Assurance Audits**

- **Boots on the Ground**
- **Systems Engineering Focus**
- **Test As You Fly**
- **Robust Ground Testing**
- **Heed Lessons Learned**

How do you ensure Mission Assurance as a *Government Employee?*

- **Stay <u>"Hands On"</u>**
- **Know your program inside and out**
- **Be a Subject Matter Expert (SME)**
- **Question decisions not supported by data**
- **Assure the appropriate Quality / Mission Assurance requirements are incorporated into the Contract**
- **Assure Quality / Mission Assurance is a voting member of the Program Award Fee Board**
- **Speak up if something is not right**

Mission Assurance is Everyone's Responsibility

How do you ensure Mission Assurance as an *Industry Partner?*

- **Maintain healthy and robust Mission Assurance program**
- **Know your suppliers**
- **Incentivize your suppliers**
- **Make decisions based on data**
- **Encourage your workforce to speak up if something is not right**

MDA-QS-001-MAP-Rev A

29 October 2006

Missile Defense Agency Assurance Provisions (MAP)

Approved by:

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Date

Mission Assurance is Everyone's Responsibility

Summary

An effective Mission Assurance Strategy must:

- **Influence program execution and behavior in order to achieve mission success**

- **Require unfettered access to the highest organizational leadership, programs and supply chain**

- **Be empowered and supported by the highest level of organizational authority**

- **Hold program offices and contractor's accountable for practices impacting mission success**

Mission Assurance is Everyone's Responsibility

Questions?