Flight Test Success through Effective Mission Assurance Strategy

19 November 2008
Mr. Larry Easterwood
MDA/QS Deputy Director - RSA

DISTRIBUTION STATEMENT A.
Approved for public release; distribution is unlimited.
**Flight Test Success through Effective Mission Assurance Strategy**

MDA/QS Deputy Director - RSA

See also ADM202644, AIAA Missile Sciences Conference Held in Monterey, California on November 18-20, 2008, The original document contains color images.
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

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

<table>
<thead>
<tr>
<th>THAAD PD&amp;RR Findings</th>
<th>THAAD Program Changes</th>
</tr>
</thead>
</table>
| 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

<table>
<thead>
<tr>
<th>Flight</th>
<th>Date</th>
<th>Demonstrated Objective</th>
<th>Video</th>
</tr>
</thead>
<tbody>
<tr>
<td>FT-10</td>
<td>10-Jun-1999</td>
<td>High lofted trajectory unitary target intercept</td>
<td>Video</td>
</tr>
<tr>
<td>FT-11</td>
<td>02-Aug-1999</td>
<td>High lofted trajectory separating target intercept</td>
<td></td>
</tr>
</tbody>
</table>
# History of THAAD Flight Test Successes

**THAAD WSMR Flight Test Successes**

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

### THAAD PMRF Flight Test Successes

<table>
<thead>
<tr>
<th>Flight</th>
<th>Date</th>
<th>Demonstrated Objective</th>
<th>Video</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTT-06</td>
<td>26-Jan-2007</td>
<td>High Endo Intercept of a Unitary Target</td>
<td>Video</td>
</tr>
<tr>
<td>FTT-07</td>
<td>05-Apr-2007</td>
<td>Mid Endo Intercept of a Unitary Target</td>
<td>Video</td>
</tr>
<tr>
<td>FTT-08</td>
<td>26-Oct-2007</td>
<td>Exo Intercept of a Unitary Target</td>
<td>Video</td>
</tr>
<tr>
<td>FTT-09</td>
<td>25-Jun-2008</td>
<td>Low Endo Intercept of a Separating Target</td>
<td>Video</td>
</tr>
<tr>
<td>FTT-10</td>
<td>15-Sep-2008</td>
<td>Exo Intercept of a Separating Target</td>
<td></td>
</tr>
</tbody>
</table>
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 “Hands On”
• 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

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?