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OPERATIONAL TEST
AND EVALUATION

JUN 30 2010

MEMORANDUM FOR PRINCIPAL DEPUTY UNDER SECRETARY OF DEFENSE
(ACQUISITION, TECHNOLOGY AND LOGISTICS)

SUBJECT: State of Reliability

I am writing to underscore the importance of system reliability as a major problem for Department of Defense (DoD) acquisitions. Poor reliability is a problem with major implications for cost. In particular, we have an opportunity to change system development to substantially reduce fielded system sustainment costs. The following data demonstrates sustainment costs – which are related directly to reliability – dominate total system costs:

Type System	RDT&E	Procurement	Operations & Sustainment
Fixed Wing Fighters	9%	30%	62%
Ground Systems	4%	24%	73%
Rotary Wing	6%	29%	64%
Surface Ships	1%	31%	68%

Sustainment costs have five to ten times more impact on total life cycle costs than do RDT&E costs. Unreliable systems have higher sustainment costs because, quite plainly, they break more frequently than planned. If we improve system reliability in development it will reduce sustainment cost. Studies DOT&E has sponsored indicate at least a seven-fold payback for this up-front investment in better reliability.

Discussions that have occurred among our staffs participating in the re-convened Reliability Working Group indicate that there is some question as to whether reliability is an important issue, and there also appear to be questions about the merits of the reliability standard ANSI/GEIA-STD-0009.

There is no question the systems emerging from our design and development efforts are often not reliable. Poor reliability leads to higher sustainment costs for replacement spares, maintenance, repair parts, facilities, staff, etc. Poor reliability hinders warfighter effectiveness and can essentially render weapons useless. For example, the Early-Infantry Brigade Combat Team (E-IBCT) unmanned aerial system (UAS) demonstrated a mean time between system aborts of 1.5 hours, which was less than $1/10^{th}$ the requirement. It would require 129 spare UAS to provide sufficient number to support the brigade's operations, which is clearly infeasible. When such a failing is discovered in post-design testing – as is typical with current policy – the

program must shift to a new schedule and budget to enable redesign and new development. For example, it cost $700M to bring the F-22 reliability up to acceptable levels.

The essential issue of reliability is that it competes with achieving more operant capabilities. A reliable system is sturdy. It weighs more. It is more expensive. If the decision to develop capabilities is made in the absence of the design constraints forced by realistic battlefield reliability needs, then programs waste time and money developing capabilities that cannot be suitably realized. Similarly, it is clear that industry will not bid to deliver reliable products unless they are assured the government expects and requires all bidders to take the actions and make the investments up-front needed to develop reliable systems. To obtain reliable products, we must assure vendors' bids to produce reliable products outcompete the cheaper bids that will not.

Reliability constraints must be pushed as far to the left as possible. We need to change what is routinely done. Despite recent and serious attempts by some in DoD to improve the focus on reliability, our data show the overall situation is not improving. Over the 25 years of DOT&E's existence, only about 75 percent of defense systems are found to be suitable in operational testing. At the time of the DSB, DOT&E's Annual Report cited:

For 2007: 4 of 8* (50 percent) of programs were found not suitable
For 2008: 2 of 6* (33 percent) of programs were found not suitable
*(*Number of Beyond Low-Rate Initial Production reports prepared by DOT&E)*

Our 2009 Annual Report shows no improvement for suitability in the past year. We looked at compliance with the acquisition policy mandating a reliability growth program. We found that only 44 percent of programs on oversight and reviewed have a reliability plan, and only 45 percent of programs are tracking reliability. Of the programs on DOT&E's current oversight list that have completed IOT&E, 66 percent met their reliability requirements.

In May 2008, a Defense Science Board (DSB) report concluded that "High suitability (reliability) failure rates were caused by the lack of a disciplined systems engineering process, including a robust reliability growth program." The most important reaction to this problem, according to that analysis, was to include reliability in system design at its onset:

- "single most important step...is to ... execute a viable systems engineering strategy from the beginning, including a robust reliability, availability, and maintainability (RAM) program"

We know the problem persists. We know that it results in higher costs and less effective systems. We know more stringent engineering is required to deliver reliable

products. To that end, industry must be made aware that all our contracts will require, at a minimum, the system engineering practices of ANSI/GEIA STD-0009.

I understand that directing use of ANSI/GEIA STD-0009 is a change from business as usual. That change is urgently needed. Requiring the use of 0009 is appropriate for the following reasons:

- 0009 is credible. To obtain an ANSI certification, 0009 was peer reviewed by 350 subject matter experts (SMEs) from all walks of the reliability community, including government, Services, academia, and industry.
- 0009 is new, different, necessary. ANSI/GEIA STD-0009 is not similar to MIL-STD-785B. The two standards are quite different, and MIL-STD-785B will not suffice. MIL-STD-785B required a "level- of-effort" and discrete tasks, but not system engineering processes. MIL-STD-785B had no systematic processes to identify and mitigate failure modes throughout the product life cycle. 0009 corrects the failings of 785B.
- 0009 has become a model for others. Since publication of ANSI/GEIA STD-0009, major standards such as SAE JA 1000 and IEEE 1332 are now being rewritten to embrace the science-based, closed-looped approach of ANSI/GEIA STD-0009.
- 0009 has been formally adopted by DoD (August 20, 2009) for use. ANSI/GEIA STD-0009 will ensure a systems level approach to identify and mitigate failure modes until requirements are met.

Examples of specific system reliability problems the Department has encountered and continues to encounter are attached. My point of contact for further information or clarification is Dr. Eric Loeb, 703.695.4557, eric.loeb@osd.mil.

J. Michael Gilmore
Director

Attachment:
As stated

cc:
Director, Systems Engineering
Deputy Director, Program Acquisition & International Contracting

Examples of Specific System Reliability Problems
Reliability Problems are Pervasive Across all Services and All Types of Systems

Early Infantry Brigade (E-IBCT) Increment 1

We cite this example first because, of all the Services, the Army has the most intense focus on reliability. Yet, even Army systems have serious reliability problems, and those problems span across system components. Bottom-line: Reliability desired for E-IBCT Increment 1 systems is not achievable without an extensive design-for reliability effort.

During the Limited User Test (LUT), August - September 2009, and the Non Line of Sight Launch System Flight Test, January - February 2010, the demonstrated operational reliability for each of the systems fell significantly below the user threshold requirements.

Non Line of Sight Launch System (NLOS-LS) -During the LUT, 2 of 6 missiles fired achieved target hits and 4 missed their targets. Two of the missiles impacted 14 or more kilometers short.

Network Integration Kit (NIK) - demonstrated 33 hour mean time between system abort versus requirement of 112 hours. (Army supplier had predicted reliability of 1615 hours MTBSA.)

Class I Block 0 Unmanned Aerial System - demonstrated mean time between system abort of 1.5 hours vs 23 hour requirement.

Small Unmanned Ground Vehicle Block 1 (SUGV) - demonstrated 5.2-hour mean time between system abort vs 42 hour requirement.

Urban Unattended Ground Sensor (U-UGS) - demonstrated mean time between system abort of 25 hours vs 105 hour requirement. (Army supplier had predicted reliability of 4187 hours MTBSA.)

Tactical Unattended Ground Sensor (T-UGS) - demonstrated mean time between system abort of 52 hours vs 127 hour requirement. (Army supplier had predicted reliability of 1258 hours MTBSA.)

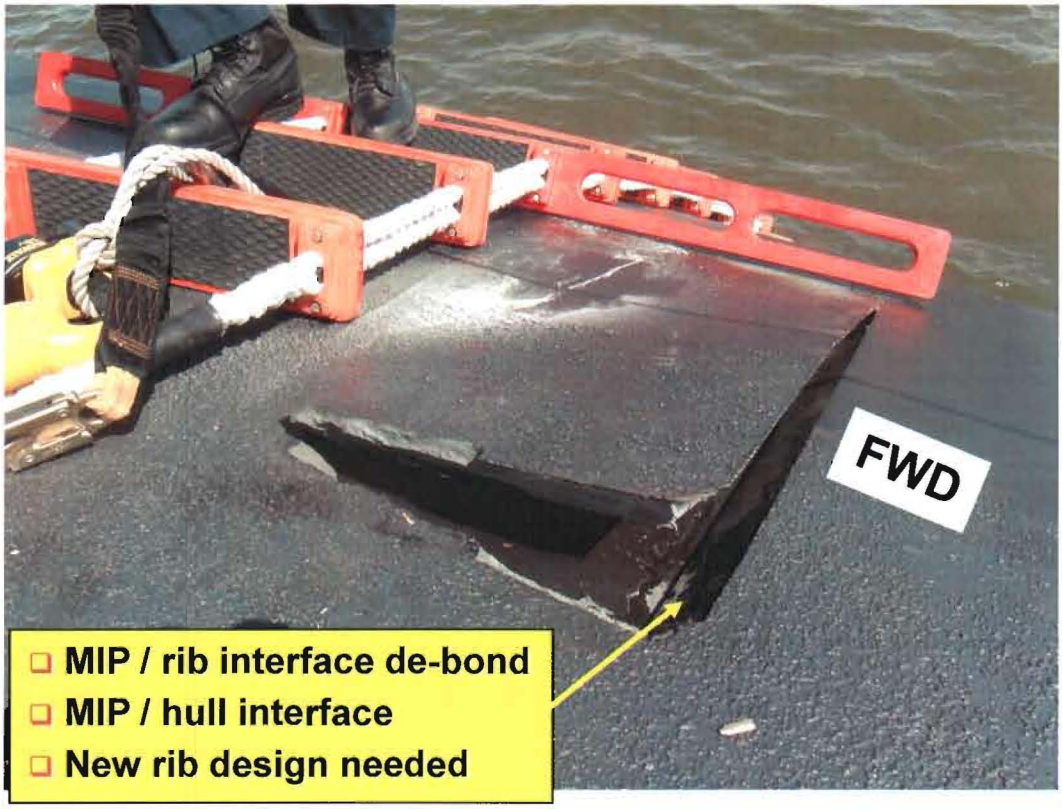
VIRGINIA Class Submarine

An OSD Program Support Review (Nov 2009) found:

- Multiple "fail to sail" issues, and test aborts associated with low reliability;
- No enterprise wide reliability measurement or growth program;
- Multiple subsystem failures associated with low reliability

AN/TB-29 Towed Array, Imaging / photonics mast, AN/BPS-16 radar, AN/WLY-1 sensors, Total Ship Monitoring System, Vertical Launch System tubes;

- Additional subsystems require reliability improvements (Active Shaft Grounding System, Circuit D, Ship Service Turbine Generator magnetic levitation bearings / throttle control system, etc.) ;
- Special Hull Treatment continues to debond from VIRGINIA Class submarines during underway periods, often in large sections up to hundreds of square feet (photo below from OSD Program Support Review, 2009).



Warfighter Information Network – Tactical (WIN-T)

Testing in June 2010: Mean Time Between Essential Function Failure (MTBEFF) did not meet requirements, due to many reliability issues. All are with supporting systems.

Supporting System	MTBEFF (Hrs) Required/Observed
Tactical Communications Node	900/196
Point of Presence	900/134
Soldier Network Extension	300/60
Network Operations Security Center	900/438

Joint Air-to-Surface Standoff Missile (JASSM)

In 2007, the program was 5 years past production decision. Production missiles experienced 4 failures during 4 lot tests; overall missile reliability rate was less than 60%. Procurement was stopped until GPS and fuse failures, production quality, and the reliability assessment method being used were corrected. On the method: the contractor ignored failure history once they thought they had fixed a failure – giving an unreasonably high, and incorrect, expectation for system reliability. This is the discredited Lloyd-Lipow reliability model: it is equivalent to counting only the *unpaid* speeding tickets to determine a driver's current probability of breaking the speed limit. The Nunn-McCurdy ADM (Dec 2007) charged the Air force to modify their agreement with Lockheed Martin to use the "Crow Extended Reliability Model" as the proper reliability assessment method.

Stryker Mobile Gun System (MGS)

During the October 2007 Initial Operational Test, it demonstrated 53 Mean Rounds Between System Abort; 81 MRBSA is required.

Amphibious Transport Dock LPD-18

(Aug 2008) Two years after amphibious transport dock New Orleans was delivered, the propulsion system was unreliable, causing a 10-hour delay before it could put to sea for its final contract trials. The Rolling Airframe Missile launchers: both fired just 1 missile at targets and then lost power, forcing crews to reset computer systems; well deck's ventilation fans didn't work; vehicle ramps were inoperative. The ships are so unreliable that I have evaluated them as not operationally effective for combat.