DEPARTMENT OF THE ARMY
ASSISTANT SECRETARY OF THE ARMY
ACQUISITION LOGISTICS AND TECHNOLOGY
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WASHINGTON DC 20310-0103

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MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Reliability of U.S. Army Materiel Systems

Emerging data shows that a significant number of U.S. Army systems are failing to demonstrate established reliability requirements during operational testing and many of these are falling well short of their established requirement. This is particularly troubling given that reliability is a driver for weapon system availability and ownership costs. In order to address this systemic issue, a program manager needs to identify systems that are seriously off-track early during the System Development and Demonstration (SDD) phase and pursue cost effective corrective action. I am directing the following actions be taken in order to implement such an early-warning mechanism.

Effective immediately, a SDD reliability test threshold will be established for all programs with a Joint Potential Designator of Joint Requirements Oversight Council, "Interest" in accordance with Chairman of the Joint Chiefs of Staff Instruction 3170.01F dated May 1, 2007. This policy shall apply to programs that are in pre-Milestone B phase and to Information Technology systems that include hardware development. The threshold shall be established before entrance into Milestone B to ensure that the reliability threshold requirement is incorporated into solicitations for the SDD effort. Enclosure 1 outlines the process for establishing and reporting the new reliability threshold, as well as a mechanism for detecting and reporting threshold breaches. The routine use of this process and the implementation of reliability best practices (Enclosure 2) will help the U.S. Army to achieve its reliability requirements.

This new policy will be incorporated in the next revisions of Army Regulation 70-1, Army Acquisition Policy, and Army Regulation 73-1, Test and Evaluation Policy.

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Enclosures

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SDD Reliability Test Threshold Process

1. Establish and Record Threshold: The Reliability, Availability, Maintainability (RAM) Subgroup to the Program Managers T&E Working-level Integrated Product Team (WIPT), in coordination with the Army Test and Evaluation Command (ATEC) will develop an SDD reliability threshold for the system.

   a. The threshold will be established early enough to be incorporated in the SDD contract.

   b. When a threshold is not established, the default value for the threshold value(s) will be 70% of the reliability threshold requirement(s) specified in the Capabilities Development Document (CDD).

   c. The threshold must be demonstrated with at least 50% statistical confidence.

   d. The threshold shall be approved as part of the Test and Evaluation Master Plan (TEMP) and recorded in the Acquisition Program Baseline at Milestone B.

   e. Application of the threshold to the reliability metrics that impact the Materiel Availability KPP or the Ownership Cost KSA shall be included in the SDD contract.

2. Test and Evaluation Planning: The TEMP will include T&E planning for evaluation of the reliability threshold.

   a. The program will be expected to meet or exceed the reliability threshold value at the end of the first full-up, integrated, system-level Developmental Test (DT) event in SDD.

   b. The T&E WIPT's RAM Subgroup will define what constitutes this DT event. Earlier DT events may also be needed in order to surface failure modes that are difficult to identify with reliability modeling and simulation.

   c. In advance of the threshold DT event, ATEC, with support from the Army Materiel Systems Analysis Activity (AMSAA), will periodically review the materiel developer's Reliability Case documentation, along with any test data, to determine if the system is on a path to achieving the reliability threshold and report findings to the system RAM Subgroup of the T&E WIPT. (Preparation and updating of the Reliability Case is the responsibility of the Program Manager (PM) and is ordinarily included in the SDD contract). Additional information on the Reliability Case may be found in Reliability Best Practices (Enclosure 2).

   d. Achievement of this threshold will be a major focus during Design Readiness Reviews.

3. Threshold Assessment: ATEC will conduct an analysis/evaluation of the DT event used to demonstrate the reliability threshold value. If a threshold breach occurs, an in process review led by ATEC will convene to address the following:

- PM's planning and implementation of Corrective Actions (CA), the projected reliability as the CAs are implemented, and the programmatic impacts.
- Army Evaluation Center's (AEC) assessment of the PM's CA plan, the system's limitations/capabilities given the current level of reliability maturity, the projected reliability, and the risk of the program not getting back "on track."

- AEC, with support from the PM and AMSAA, will estimate ownership costs impacts of the current reliability maturity level.
- Training and Doctrine Command will assess the utility of the system given its current level of reliability maturity.

The CG of ATEC will provide the ASA ALT, thru the Army T&E Executive, a recommendation along with the above supporting documentation. Coordination with the Program Executive Officer (PEO) will occur in advance of the threshold breach report to ASA ALT.

Reliability Best Practices

- The supplier routinely builds and updates a "Reliability Case" during product development. The Reliability Case documents the supplier's understanding of the reliability requirements, the plan to achieve the requirements, and a regularly-updated analysis of progress towards meeting the requirements. The Reliability Case provides the Government assurance that the contractor is aggressively pursuing design practices and testing activities consistent with industry high performers. Information on the Reliability Case can be found in the Society of Automotive Engineers JA1000 series standard or the United Kingdom Ministry of Defense Standard 00-42, Part 3, dated 6 June 2003. The Reliability Case has been successfully used by the United Kingdom Ministry of Defense and within the US Army Future Combat System program.
- The supplier conducts routine technical assessments of each reliability parameter based on known design configuration and knowledge throughout development emphasizing early assessments (prior to major design reviews System Requirements Review, System Functional Review, Preliminary Design Review and Critical Design Review as a minimum).
- The supplier understands the rationale for the user's reliability and maintainability requirements and conducts routine technical interchanges throughout development in order to understand and mature the user's failure and maintenance definitions and scoring criteria based on the supplier's latest detailed design configuration of the system.
- The supplier does not rely on handbook predictions as an indicator of design status and maturity. Reliability predictions, based on handbooks or similar approaches, are historically highly inaccurate and can lead to poor design decisions. Suppliers and organizations in their supply chain that quote predictions may not understand the engineering and design considerations necessary to minimize risk and to produce a reliable design.
- The supplier does not equate increases in reliability with huge increases in cost. In many cases, significant improvements in reliability can be achieved at minimal cost, especially when reliability improvement is addressed as part of the design process. Suppliers that see reliability increasing only through a test-fix-test-fix-test process will likely not produce a cost-effective and reliable product.
- The supplier routinely conducts thermal and vibration analyses to address potential failure mechanisms and failure sites (i.e., a physics-of-failure approach to reliable design). These analyses would likely include the use of fatigue analysis tools, finite element modeling, dynamic simulation, heat transfer analyses, etc. Overall, the supplier should have an integrated approach to design out many failures early in the development process.
- The supplier has characterized the critical loads and stresses. A good design team will characterize the life cycle environment and operational duty cycle stresses that their components will see. Sometimes this will require additional testing and data collection. Without knowing the environment that a given component will operate in, or at least some reasonable bounds for the usage environment, a design team cannot be confident that a given component will be reliable.

- The supplier routinely conducts low-level testing starting very early in the development process. The supplier also conducts significant integration testing. The supplier should routinely share these results, along with the results of the failure mechanism modeling described above, with the customer to demonstrate and provide progressive assurance that the development program is on track to produce a system that meets the specified reliability requirements.
- Prior to entering formal system-level test, the supplier should have an engineering-based reliability assessment to show that there is a high probability of passing the test.
- The supplier's design team for the given system has a history of producing reliable hardware and software.
- The supplier knows what the reliability challenges are and knows what the likely failure mechanisms and failure sites will be.
- The supplier conducts highly accelerated life testing and highly accelerated stress screening. These tests should be conducted with specific failure mechanisms in mind. Corrective actions need to be identified and implemented.
- The supplier conducts early testing that is specifically designed to precipitate failures so that the design can be improved early in the program.
- The supplier has quality control procedures in place to make sure the full reliability potential of the design is maintained. The supplier understands the manufacturing, material, and assembly variability and how this variability affects reliability.
- The supplier has a closed-loop Failure Reporting And Corrective Action System (FRACAS). This program has to be well structured and be directly tied into the design team. It must collect all of the information necessary to track and correct deficiencies. The FRACAS should be under the purview of a failure review board that has the power and commitment to allocate resources to fix problems.
- The supplier uses reliability engineering and management tools like Failure Modes and Effects Criticality Analysis (FMECA) and Reliability Growth. It is critical that these tools and analyses be directly linked to the design team. A supplier may perform these reliability tasks and yet not use the results to influence the design and to focus design team efforts. Also, handbook predictions should not be used in FMECA.
- The supplier has considered embedded instrumentation per CJCSI 3170.01F by incorporating diagnostics, prognostics, testing, and training into the design early in the development process and has assessed a number of options to include time-history based prognostics, precursor-based prognostics, and stress-history based prognostics.
- The supplier has a high-level and continuous focus on reliability improvement. The design team is fully aware of the importance of high reliability and reliability is given a high priority.
- The supplier has a sufficiently-sized reliability engineering staff that is directly tied to the design team.
- The supplier has a reliability program plan that is based upon realistic timelines, testing, and design activities that will produce a product that meets the reliability

requirements. Realistic delays associated with incorporating fixes should be identified and incorporated into the plan.

- The supplier does not view reliability as just Mean Time Between Failure (MTBF). Instead, the supplier is focused on building a product that has a significant failure-free operating period. The supplier should address probabilistic analysis as part of design.
- The supplier has well established and documented reliability and quality lessons learned.
- The supplier has identified all the limited-life components. A cost effective replacement policy has been formulated for these components to maintain an adequate level of reliability throughout the system's lifecycle.
- The supplier has analyzed and fully understands their supply chain. The supplier understands the reliability risks and design/manufacturing practices of the component and subassembly suppliers. The supplier has also analyzed the potential for obsolescence of parts.
- The supplier has a history of applying innovative approaches to reliability (e.g., simplifying designs and improving manufacturing processes).
- The supplier incorporates parts, materials, and processes management in the overall systems engineering approach to assure proper application of parts, materials, and processes corresponding to the system life cycle stresses and reliability requirements.
- The supplier understands the Army's business transformation framework using Lean, Six Sigma and further understands and applies the Design for Lean, Six Sigma logic, tools, rigor and discipline in assuring Design for Reliability is an integrated approach to design, systems, and supportability engineering.
- The supplier understands and applies Nondeterministic Analysis and Probabilistic Technology to: design, systems and supportability engineering. The supplier understands the implications of "uncertainty" on decision-making and assures quantification and accountability to preclude unknown consequences. Physics-based probabilistic methods should eliminate safety factors as sources of unquantified uncertainty.
- Physics-based probabilistic analysis is used throughout the life cycle beginning in the conceptual design phase in order to determine the criticality and sensitivity of various subsystems/components to system reliability and life-cycle cost thereby focusing design, modeling & simulation and test & evaluation.