ORGANIZATIONAL MISSION ASSURANCE STANDARD

Reliability, Maintainability, Availability, and Dependability Program ***SET ™***

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STANDARD

OBJECTIVE

This Standard defines *SET*'s approach for implementing a Reliability, Maintainability, Availability and Dependability (RMAD) Program. Through the interpretation and implementation of this Standard, *SET* will tailor RMAD Programs to achieve all pertinent mission assurance requirements which are commensurate with the unit-value/criticality of its products. At the time this Standard was written, *SET* did not develop any very-high or ultra-high unit-value products.

Note: Guidance for product unit-value/criticality determination is found in Figure 1.

APPLICABILITY

This Standard applies to all present and future *SET* sites/facilities, programs/projects, business lines/services, functional organizations/working groups, and employees/subcontractors, regardless of whether an RMAD Program has been contractually imposed.

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1. Introduction

This Standard establishes the general requirements for a Space Environment Technologies (*SET*) Reliability, Maintainability, Availability and Dependability (RMAD) Program.

1.1 Scope

This Standard applies to all present and future *SET* sites/facilities, programs/projects, business lines/services, functional organizations/working groups, and employees/subcontractors, regardless of whether an RMAD Program been contractually imposed.

1.2 Purpose

SET's RMAD Programs are authorized in accordance with this Standard, with responsibility and authority to

1) Ensure all reliability, maintainability, availability, and dependability risks are balanced within the project's objectives, constraints, and budget,

2) Evaluate potential failure modes across the product life cycle, as applicable, and

3) Quantify the inherent and operational reliability of the product.

The implementation of an RMAD Program to evaluate potential failure modes during the design, manufacture, assembly, testing, transportation, and operational phases of all high unit-value products, will be required either by contract or by this Standard. If the planning for an RMAD Program does not address all of the pertinent requirements called out in the contract or this Standard, then the Lead Reliability Engineer (LRE) will provide documented evidence that verifies only negligible or non-credible failure modes are associated with the requirements not addressed.

Through the interpretation and implementation of this Standard, *SET* will define and implement RMAD Programs that are commensurate with the unit-value/criticality and product life cycle of the products they are applied to. Figure 1 provides *SET's* product unit-value/criticality categorization.

Figure 1. SET Product Unit-Value/Criticality Categorization.

Ultra-High Unit-Value / Criticality Products	Very-High Unit-Value Criticality / Products	High Unit-Value / Criticality Products	Medium Unit-Value / Criticality Products	Low Unit-Value / Criticality Products
• Defense satellites • Launch vehicles • Long-range missiles • Nuclear weapons • Nuclear power plants	• Commercial / communications satellites • Fossil fuel / hydro-electric power plants • Oil tankers • Off shore oil rigs • Water filtration plants • Short-range missiles/rockets • Passenger aircraft / helicopters • Military aircraft / helicopters • Military drones / unmanned vehicles • Naval vessels • Passenger trains / buses • Cruise liners • Safety-critical hardware / software components • Satellite ground control stations	• Science satellites • Cargo ships • Mobil / mechanized weapons • Freight trains • Amusement park rides • Elevators / escalators • Small private aircraft / helicopters • Automobiles / trucks / motorcycles • Mission-critical hardware / software components • Construction / demolition / excavation equipment • Satellite communications relay stations	• Industrial electronics • Personal computers / peripherals • Industrial computers / peripherals • Farm equip • Medical / laboratory equip • Factory machinery • Handheld construction / demolition / excavation equip • Communications / utility equip • Explosive devices • Test / monitoring hardware/software components • Computer operating system software • Prototype systems / components	• Motorized / manual hand tools • Fire arms • Consumer electronics • Household appliances • Batteries • Battery operated toys • Infant/ children toys • Computer application program software

2. REFERENCES

2.1 Normative References

The following reference documents of the issue in effect on the date on invitation for bid or request for proposal form a part of this Standard to the extent specified:

AIAA S-102.1 Mission Assurance Management

1) AIAA S-102.0.1 (Draft)	Mission Assurance Program General Requirements
2) AIAA S-102.1.1 (Draft)	Mission Assurance Program Planning Requirements
3) AIAA S-102.1.2 (Draft)	Subcontractor and Supplier Mission Assurance Management Requirements
4) AIAA S-102.1.3 (Draft)	Mission Assurance Working Group (MAWG) Requirements
5) AIAA S-102.1.4 (Released)	Failure Reporting, Analysis and Corrective Action System (FRACAS) Requirements
6) AIAA S-102.1.5 (Released)	Failure Review Board (FRB) Requirements
7) AIAA S-102.1.6 (Draft)	Critical Item Risk Management (CIRM) Requirements
8) AIAA S-102.1.7 (Draft)	Project Mission Assurance Database System Requirements
9) AIAA S-102.1.8 (Draft)	Quality Assurance (QA) Requirements
10) AIAA S-102.1.9 (Draft)	Configuration Management (CM) Requirements
11) AIAA S-102.1.10 (Draft)	Environmental Safety Assurance Requirements

AIAA S-102.2 Mission Assurance Engineering and Analysis

12) AIAA S-102.2.1 (Draft)	Functional Diagram Modeling (FDM) Requirements
13) AIAA S-102.2.2 (Released)	System Reliability Modeling Requirements
14) AIAA S-102.2.3 (Draft)	Component Reliability Predictions Requirements
15) AIAA S-102.2.4 (Released)	Product Failure Mode, Effects and Criticality Analysis (FMECA) Requirements
16) AIAA S-102.2.5 (Draft)	Sneak Circuit Analysis (SCA) Requirements
17) AIAA S-102.2.6 (Draft)	Design Concern Analysis (DCA) Requirements
18) AIAA S-102.2.7 (Draft)	Finite Element Analysis (FEA) Requirements
19) AIAA S-102.2.8 (Draft)	Worst Case Analysis (WCA) Requirements
20) AIAA S-102.2.9 (Draft)	Human Error Predictions Requirements
21) AIAA S-102.2.10 (Draft)	Environmental Event Survivability Analysis Requirements

22) AIAA S-102.2.11 (Released) Anomaly Detection and Response Analysis Requirements

23) AIAA S-102.2.12 (Draft) Maintainability Predictions Requirements

24) AIAA S-102.2.13 (Draft) Operational Dependability and Availability Modeling Requirements

25) AIAA S-102.2.14 (Draft) Hazard Analysis (HA) Requirements

26) AIAA S-102.2.15 (Draft) Software Component Reliability Predictions Requirements

27) AIAA S-102.2.16 (Draft) Process Failure Mode, Effects, and Criticality Analysis (FMECA) Requirements

28) AIAA S-102.2.17 (Draft) Event Tree Analysis (ETA) Requirements

29) AIAA S-102.2.18 (Draft) Fault Tree Analysis (FTA) Requirements

30) AIAA S-102.2.19 (Draft) Fishbone Analysis Requirements

31) AIAA S-102.2.20 (Draft) Similarity and Allocations Analysis Requirements

32) AIAA S-102-2.21 (Draft) Component Engineering Requirements

33) AIAA S-102.2.22 (Draft) Stress and Damage Simulation Analysis Requirements

AIAA S-102.3 Mission Assurance Testing

34) AIAA S-102.3.1 (Draft) Environmental Stress Screening (ESS) Requirements

35) AIAA S-102.3.2 (Draft) Reliability Development / Growth Testing (RD/GT) Requirements

36) AIAA S-102.3.3 (Draft) Reliability, Maintainability, and Availability Demonstration Testing Requirements

37) AIAA S-102.3.4 (Draft) Reliability Life Testing Requirements

38) AIAA S-102.3.5 (Draft) Design of Experiments Requirements

39) AIAA S-102.3.6 (Draft) Ongoing Reliability Testing (ORT) Requirements

40) AIAA S-102.3.7 (Draft) Product Safety Testing Requirements

Corporate References

41) Reliability Design Rules (Draft)

42) Joint Services Software Safety Design Rules (Released)

2.2 Relationship to Other Corporate Standards

This Standard is over-arched by the Corporate Standard for the Mission Assurance Program (MAP). This Standard defines the RMAD Program processes and the set of activities that comprise each process. These activities aid identification, evaluation, and mitigation or control of existing and potential failure modes.

3. Terminology

3.1 Terms and Definitions

anomaly
apparent problem or failure affecting a configured product, process, or support equipment/facilities that is detected during product verification or operation
NOTE: Anomalies are distinguished from discrepancies, product defects which do not violate project requirements which may or may not be documented in the FRACAS.

acquisition authority
an organization (Government, contractor, or subcontractor) that levies requirements on another organization through a contract or other document

approximation[1]
a value that is nearly but not exactly correct or accurate

audit
an independent examination of accounts and records to assess or verify compliance with specifications, standards, contractual agreements, or other criteria (Ref. IEEE STD 1624-2008)

baseline process
the minimum set of functions that constitute a specific type of process

baseline program
the minimum set of functions that constitute a specific type of program

capability
one or more processes or activities that describe how SR&QA programs are used, treated, or developed within an organization (Ref. IEEE STD 1624-2008)

capability-based system safety program
the set of processes that assesses and controls product deficiency risk at one or more predefined capability levels

capability level
measure of the ability of a system safety process, as specified by a set of activities, to address the pertinent system safety needs of a systems engineering process

capability level growth
a measurable improvement (e.g., an increase in resources, scope of effort, or maturity of input data) in the ability of a system safety process to support the system safety needs of a systems engineering process

[1] Definition source: IEEE 100, *The Authoritative Dictionary of IEEE Standards Terms*

chaos
the random occurrence of unpredictable and unrelated events

control
a method used to reduce the consequences, likelihood, or effects of a hazard or failure mode
NOTE: Controls include special design features, procedures, inspections, or tests

credible failure mode or hazard
a failure mode or hazard with a probability of occurrence greater than $1.0E^{-6}$, 0.000001, or one in a million

engineering judgment
a properly trained engineer's technical opinion that is based on an evaluation of specific data and personal experience
NOTE: Engineering judgments are a reality that cannot not be avoided when insufficient time, data, or funding are available to perform a detailed quantitative analysis.

environmental safety assurance
to give appropriate consideration to potential environmental impacts prior to beginning any action that may significantly affect the environment

estimation
a tentative evaluation or rough order magnitude calculation

failure
termination of the ability of a unit to perform its required function
NOTE: A fault may cause a failure.

failure mode
consequence of the mechanism through which a failure occurs, or the manner by which a failure is observed

fault[2]
[1] [Software reliability] a manifestation of an error in software; [2] [Hardware reliability] any undesired state of a component or system; [3] [Components] a defect or flaw in a hardware or software component; [4] [Human reliability] procedure (operational or maintenance) or process (manufacture or design) that is improperly followed;
NOTES: [1] An accident may cause a fault; [2] A fault may cause a failure; [3] A fault does not necessarily require failure.

hazard
a condition that is prerequisite to a mishap and a contributor to the effects of the mishap
NOTE: A single point failure mode (SPFM) item is a hazard with respect to its potential to lead directly to loss of a safety-critical or mission-critical system function.

[2] Definition source: IEEE 100, *The Authoritative Dictionary of IEEE Standards Terms*

maturity level
measure of the degree of accuracy of a data product, as developed using a specified set of input data, in relation to what is considered the best achievable results

method
a formal, well-documented approach for accomplishing a task, activity, or process step governed by decision rules to provide a description of the form or representation of the outputs (C/SE) 1220-1994s

mishap
an unplanned event or series of events resulting in death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment

mission
the purpose and functions of the space system (sensors, transponders, boosters, experiments, etc.) throughout its expected operational lifetime, and controlled reentry or disposal orbit time period. A space system may have multiple missions (e.g., primary mission, ancillary mission, and safety mission)

mission assurance
the program-wide identification, evaluation, and mitigation or control of all existing and potential deficiencies that pose a threat to system safety or mission success, throughout the product's useful life and post-mission disposal
NOTE: Deficiencies include damaging-threatening hazards, mission-impacting failures, and system performance anomalies that result from unverified requirements, optimistic assumptions, unplanned activities, ambiguous procedures, undesired environmental conditions, latent physical faults, inappropriate corrective actions, and operator errors.

mission capability
This term encompasses the purpose and functions of the space system (sensors, transponders, etc.) throughout its intended system mean mission duration (the expected life of the space vehicle). (Ref. AFMAN 91-222 SUPL1)

mitigation
(1) a method that eliminates or reduces the consequences, likelihood, or effects of a hazard or failure mode; (2) a hazard control

modeling
act of producing a representation or simulation of one or more items

non-credible failure mode or hazard
a failure mode or hazard with a probability of occurrence equal to or less than 1.0E-6, 0.000001, or one in a million
NOTE: In System Safety Engineering, the qualitative probability values of an improbable hazard and a non-credible hazard are equivalent.

plan
a method for achieving an end

practice
one or more activities that use specified inputs to develop specified work products for achieving specified objectives (Ref. IEEE Standard 1624-2008)

process-based lesson learned
important information created, documented, and retrieved according to a process or procedure descriptor

product-based lesson learned
important information created, documented, and retrieved according to a system or device life cycle specific functional or physical descriptor

program
[1] the managed collection of an organization's practices that is structured to ensure that the customers' requirements and product needs are satisfied (Ref. IEEE Standard 1624-2008); [2] a defined set of managed processes conducing to an end under a single plan
NOTE: A program does not have to consist of related, managed process. Compare with definition of *"system"*.

process
a sequence of tasks, actions, or activities, including the transition criteria for progressing from one to the next, that bring about a result (Ref. IEEE Standard 1624-2008)
NOTE: A process can be unmanaged or managed. An unmanaged or "free" process does not have its inputs or outputs controlled. The rain and melted snow that replenishes a lake is an example of an unmanaged process. A managed or "controlled" process has its inputs and outputs controlled. An electrical power station is an example of a managed process.

quality
a measure of a part's ability to meet the workmanship criteria of the manufacturer
NOTE: Quality levels for parts used by some of the handbook methods are different from quality of the parts. Quality levels are assigned based on the part source and level of screening the part goes through. The concept of quality level comes from the belief that screening improves part quality.

reliability
probability that an item will perform its intended function for a specified interval under stated conditions

residual risk
risk associated with significant failure modes or hazards for which there are no known control measures, incomplete control measures, or no plans to control the failure mode or hazard

root cause(s)
most fundamental reason(s) an event might or has occurred

root cause analysis
a process for identifying the fundamental cause of an event or failure

safety
freedom from those conditions that can cause death, injury, occupational illness, or damage to or loss of equipment or property, or damage to the environment

safety critical
a term applied to a condition, event, operation, process or item of whose proper recognition, control, performance or tolerance is essential to safe system operation or use; e.g., safety critical function, safety critical path, safety critical component

specialty engineering
a subgroup of the engineering processes that make up the Mission Assurance Process
Note: Traditionally, this subgroup includes Reliability, Maintainability, PMP, Survivability, and Supportability.

system
[1] a defined set of related processes
[2] elements of a composite entity, at any level of complexity of personnel, procedures, materials, tools, equipment, facilities, and software, that are used together in an intended operational or support environment to perform a given task or achieve a specific purpose, support, or mission requirement
NOTE: A system that consists of one or more unmanaged processes is susceptible to becoming "unbalanced" and changing over time (e.g., an ecological system). For a system to maintain stability it must be "balanced" and consist only of managed processes.

system safety
the application of engineering management principles, criteria, and techniques to optimize all aspects of safety within the constraints of operational effectiveness, time, and cost throughout all phases of the system lifecycle (Ref. MIL-STD-882C)

systems engineering
An interdisciplinary approach encompassing the entire technical effort to evolve and verify an integrated and life-cycle balance set of system product and process solutions that satisfy customer needs. (Ref. MIL-STD-499B Draft)

tailoring
process by which the individual requirements (tasks, sections, paragraphs, words, phrases, or sentences) of a standard are evaluated to determine the extent to which each requirement is most suited for a specific system acquisition and the modification of these requirements, where necessary, to ensure that each tailored document invokes only the minimum needs of the customer

timely
performance of a task, subtask, or effort when planning and execution results in the output being provided with sufficient time for management, if need be, to identify and implement cost-effective action
EXAMPLE: An action that avoids or minimizes schedule delays and cost increases.

validation
the act of determining that a product or process, as constituted, will fulfill its desired purpose

verification
the process of assuring that a product or process, as constituted, complies with the requirements specified for it

3.2 Acronyms

A_O	Availability Analysis
CA	Criticality Analysis
CIRM	Critical Item Risk Management
CN	Criticality Number
DCA	Design Concern Analysis
D_O	Dependability Analysis
ECP	Engineering Change Proposal
EOLP	End of Life Plan
ESS	Environmental Stress Screening
ETA	Event Tree Analysis
ETC	Estimate to Complete
FDM	Functional Diagram Modeling
FMEA	Failure Mode and Effects Analysis
FMECA	Failure Mode, Effects, and Criticality Analysis
FRACAS	Failure Reporting, Analysis, and corrective Action
FRB	Failure Review Board
FTA	Fault Tree Analysis
HA	Hazard Analysis
HW	Hardware
IMP	Integrated Master Plan
IMS	Integrated Master Schedule
LLAA	Lessons Learned Approval Authority
LOE	Level of Effort
MAP	Mission Assurance Program Mission Assurance Process
MAPP	Mission Assurance Program Plan

	Mission Assurance Program Planning
MCLP	Multiple Capability Level Process
O&SHA	Operating and Support Hazard Analysis
PMP	Parts, Materials & Processes
PoF	Physics of Failure
QA	Quality Assurance
R&M	Reliability and Maintainability
RD/GT	Reliability Development/Growth Testing
RMAD	Reliability, Maintainability, and Availability Demonstration
	Reliability, Maintainability, Availability and Dependability
SCA	Sneak Circuit Analysis
SCLP	Single Capability Level Process
SEC	Standards Executive Council
SEMP	Systems Engineering Management Plan
SET	Space Environment Technologies
SPFM	Single Point Failure Mode
SR&QA	Safety, Reliability & Quality Assurance
SSP	System Safety Program
SW	Software
SSWG	System Safety Working Group
TAAF	Test, Analyze and Fix
TPM	Technical Performance Metrics
V&V	Verification & Validation

4. General Requirements

SET has adopted the AIAA S-102 Mission Assurance Standards because they provide an industry-acknowledged basis for tailoring the RMAD Program to be commensurate with the unit-value/criticality and life cycle phase of the product that it is applied to. Accordingly, *SET*'s RMAD Programs will be implemented over the product life cycle in accordance with the groups of "capability-based" processes shown in Figure 2. Figure 2 shows the groups of RMAD Program processes to be implemented over the life cycle of low, medium, high, and very-high unit-value/criticality products. This "capability-based" approach to RMAD is cost-effective and repeatable, and as such, will be extensible into pristine technical territory in the future.

RMAD Program Process	Product Unit-Value/Criticality				
	Low	Medium	High	Very-High	Ultra-High
RMAD Program Planning	√	√	√	√	√
Functional Diagram Modeling	√	√	√	√	√
Product Failure Mode, Effects, and Criticality Analysis	√	√	√	√	√
Subcontractor and Supplier RMAD Management	√	√	√	√	√
Component Reliability Predictions	√	√	√	√	√
System Reliability Modeling		√	√	√	√
Design Concern Analysis		√	√	√	√
Worst Case Analysis		√	√	√	√
Environmental Event / Survivability Analysis		√	√	√	√
Software Component Reliability Predictions		√	√	√	√
Maintainability Predictions		√	√	√	√
RMAD Working Group (Includes Data Product Peer Reviews)			√	√	√
Anomaly, Detection, and Response Analysis			√	√	√
Operational Dependability and Availability Modeling			√	√	√
Similarity and Allocations Analysis			√	√	√
Stress and Damage Simulation Analysis			√	√	√
Finite Element Analysis			√	√	√
Reliability Life Testing			√	√	√
Sneak Circuit Analysis				√	√
Process Failure Mode, Effects, and Criticality Analysis				√	√
Reliability, Maintainability, and Availability Demonstration Testing				√	√
Reliability Development Growth Testing					√
Ongoing Reliability Testing					√

Figure 2. Product Life Cycle RMAD Program Implementation (Notional)

5. DETAILED REQUIREMENTS

The following detailed requirements pertain to the capability-based RMAD Program processes defined in AIAA S-102.0.1 “Mission Assurance Program General Requirements”.

5.1 Assign Responsibility and Authority for Meeting Mission Assurance Requirements and Objectives

Through the interpretation and implementation of this Standard, *SET* will assign joint responsibility and authority for meeting all of the reliability and maintainability (R&M) related requirements in a project to the RMAD Program and to all of systems engineering disciplines that are responsible for performing R&M related tasks. The key organizations and manages that that are responsible for performing R&M related tasks will be identified by name and title in the RMAD Program Plan.

5.2 Define and Flow Down RMAD Requirements

SET will define R&M related requirements which are consistent with the system requirements and this Standard, and flow them down to all affiliated subcontractors. *SET* will document these requirements in the RMAD program plan.

5.2.1 Identify RMAD Requirements Which Are Already Met

RMAD will identify all R&M related requirements that are already satisfied by an existing analysis, inspection, test report, or data product that was developed for a similar project, product, or process. Each satisfied requirement will be identified in the RMAD program plan, along with a detailed description of the legacy system, the verification method, and the observed results.

5.2.2 Identify Opposing Requirements

RMAD will identify all systems engineering requirements that oppose a R&M related requirement, and coordinate the adjudication of the conflict in accordance with the following requirement order of precedence:

1. Safety critical
2. Mission critical
3. Reliability critical
4. Maintenance critical
5. Monitoring critical

5.2.3 Define System Failure Criteria

RMAD will define the product failure criteria in the RMAD program plan. A Severity Classification will be assigned to each system failure condition and qualified or rated based on the worst case end effects on the system or mission. Definitions for severity classifications are based on the specific analytical objectives, such as, performance, mission reliability, system safety, consequential damage, service availability, etc. Table 1 provides the baseline AIAA S-102 Failure Severity Classification Criteria.

Table 1. AIAA S-102 Failure Severity Classification Criteria

FAILURE SEVERITY CLASSIFICATION	FAILURE EFFECT DESCRIPTION
CATASTROPHIC	• Failure would cause loss of life or total disability to personnel, or • Failure would cause identifiably catastrophic damage to system and repairs that are beyond the capability of the user or contractor to resolve the effects
CRITICAL	• Failure would cause severe disabling injury or severe occupational illness to personnel, or • Failure would cause identifiably critical damage to the system and extensive repairs to resolve the effects
MARGINAL	• Failure would cause minor injury or minor occupational illness to personnel that may require hospitalization, but failure is not disabling, or • Failure would cause identifiably marginal damage to the system and acceptable level of repairs and downtime to resolve effects
MINOR	• Failure would cause minor injury to personnel but those injuries would not require hospitalization, or failure would cause minor occupational illness, or • Failure would cause identifiably minor damage to the system and minor repairs and short downtime to resolve effects
NEGLIGIBLE	• Failure would cause less than minor injury and no occupational illness, or • Failure would cause negligible damage to the system and insignificant or no downtime to resolve effects, or • Failure is not credible

5.3 RMAD Program Planning in the Systems Engineering Life Cycle

The following factors will be considered, at a minimum, in the selection of RMAD program processes:

a. Unit-value of the end product based on the product unit-value categorization defined in Figure 1;

b. Applicable product life cycle phases;

c. Types of input data available for RMAD processes;

d. Applicability of capability level growth, with respect to maturation of the RMAD input data commensurate with progression of the product development live cycle;

e. Applicable mission assurance requirements; in accordance with the S-102 prioritized list of design requirements:

   i. Safety-critical

   ii. Mission-critical

iii. Reliability-critical

iv. Maintenance-critical

v. Monitoring-critical

f. Types of product deficiencies addressed by RMAD processes;

g. Assessed capability of RMAD process to achieve specific mission assurance requirements;

h. Capability of RMAD processes to be integrated cost-effectively with the project's systems engineering process.

Deviations from the S-102 prioritized list of design requirements will be explained in the RMAD Program Plan.

The projects in which a high unit-value product is developed will establish minimum qualifications for performing each RMAD process.

The descriptions of the mission assurance processes will be documented in the mission assurance program plans, all of which will be approved.

5.3.1 RMAD Program Plan

Purpose

To identify the activities essential in assuring product reliability, maintainability, availability and dependability design and performance meets requirements.

Process Description

Prepare an RMAD Program Plan to assure reliability, maintainability, availability and dependability risks are balanced against project constraints and objectives through a comprehensive effort that will contribute to system reliability over the mission life cycle. This is performed as part of the initial planning for all product development programs. The RMAD Program Plan will include a description of how each task is implemented in each program phase, including the roles of key participants, and a listing of the key outputs of each task. Figure 3 provides the applicability of RMAD Program Planning in the product life cycle.

Figure 3. Applicability of RMAD Program Planning in Product Life Cycle.

S-102.1.1	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities (*)
Medium Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.2 Subcontractor and Supplier RMAD Management

Purpose

To identify sources of products and services that may be used to satisfy reliability, maintainability, availability and dependability requirements, and to manage the pertinent activities of subcontractors and suppliers to minimize risk of latent deficiencies. To assure that the RMAD activities of the subcontractor or supplier are consistent with the overall RMAD Program, by being provided with verification of compliance, or being allowed to conduct surveillance of their reliability, maintainability, availability and dependability activities. Figure 4 provides the applicability of subcontractor and supplier mission assurance management in the product life cycle.

Process Description

Exercise monitoring and control of subcontractor and supplier reliability engineering activities; assure that their reliability program plans are complete and executable; exchange applicable reliability lessons learned with them; and if necessary, help develop their reliability capabilities. All reliability deliverables expected from the subcontractor will be called out in contractual agreements with the subcontractor. Figure 4 provides the applicability of RMAD Program Planning in the product life cycle.

Figure 4. Applicability of Subcontractor and Supplier Mission Assurance Management in Product Life Cycle.

S-102.1.2	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value		Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities (*)
Medium Unit-Value		Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value		Capability Level 1 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value		Capability Level 1 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value		Capability Level 1 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.3 RMAD Working Group

Purpose

To conduct formal and informal technical reviews, as necessary, determine the status of the RMAD program, and work reliability, maintainability, availability and dependability risks and issues to closure.

Process Description

A group of engineers that are cognizant of the project's RMAD requirements will meet periodically or spontaneously to review the status of planned reliability activities, significant failure mode risks, and any verified test failures. This working group also assures that the required follow-up actions or corrective actions are taken in a timely manner, and are properly implemented, verified, and documented. Figure 5 provides the applicability of the Mission Assurance Working Group in the product life cycle.

Figure 5. Applicability of MAWG in Product Life Cycle.

S-102.1.3	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.4 Functional Diagram Modeling (FDM)

Purpose
To develop graphical representations of the system's functional interrelationships. The primary output of FDM is a graphical diagram that represents detailed design information with regard to the functional characteristics of each system element. FDM helps achieve a common understanding, in a functional sense, of the system or system of systems among all Systems Engineering disciplines.

Process Description
Collect, process, and evaluate detailed system design information to develop a graphical representation of the system that consists of:

- The system's functional elements, including inputs and outputs of each functional element;
- The system's functional paths (e.g., wiring, tubing, logic flow, operator actions, power, signals, electromagnetic waves, forces, pressures, and mechanical motions)
- References to a description of the system's modes of operation (e.g., mission timeline, states, transitions, switching, timing, and phases);

Figure 6 provides the applicability of FDM process in the product life cycle.

Figure 6. Applicability of FDM Process in Product Life Cycle.

S-102.2.1	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities (*)
Medium Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.5 System Reliability Modeling

Purpose
To inductively perform assembly through system level reliability predictions, allocations, and assessments. This task aids in evaluating the reliability of competing designs, and provides key input to availability and sparing assessments.

Process Description
Develop a hierarchical mathematical model to estimate the probability of the system successfully performing its intended functions for a given period of time or operating cycles, and under specified operating conditions. The model will account for initial system reliability, which includes the cumulative effects of functional testing, storage, handling, packaging, transportation, assembly, and maintenance on the ability of the system to meet its operational reliability requirements. Figure 7 provides the applicability of the System Reliability Modeling process in the product life cycle.

Figure 7. Applicability of System Reliability Modeling in Product Life Cycle.

S-102.2.2	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.6 Component Reliability Predictions

Purpose

To perform part and component level reliability predictions and assessments. This task aids in evaluating the reliability of similar components, and provides key input to system reliability modeling / predictions.

Process Description

Develop a mathematical model to estimate the failure rate or hazard rate of the component for a given operating mode, operating cycles, and under specified operating conditions. Figure 8 provides the applicability of the Component Reliability Predictions in the product life cycle.

Figure 8. Applicability of Component Reliability Predictions in Product Life Cycle.

S-102.2.3	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities (*)
Medium Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.7 Product Failure Mode, Effects and Criticality Analysis (FMECA)

Purpose

To identify effects of potential failure modes, system redundancy features, responses to system failures, single point failure modes, and critical items which require special controls during processing. The Product FMECA identifies all functional failure modes that pose unacceptable risk.

Process Description

Perform a systematic analysis of the local and system level effects of specific component failure modes, and also evaluate the mission criticality of each failure mode. An FMEA/FMECA is prepared whenever a system functional block diagram is available, and should be updated throughout the system development cycle. Figure 9 provides the applicability of Product FMECA process in the product life cycle.

Figure 9. Applicability of Product FMECA Process in Product Life Cycle.

S-102.2.4	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities	Capability Level 1 Activities (*)
Medium Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.8 Sneak Circuit Analysis (SCA)

Purpose

To analyze a system to identify and eliminate or control latent conditions that may that may cause occurrence of an unwanted function or the inhibition of a desired function.

Process Description

Perform a structured analysis to uncover the following types of latent or sneak conditions:

- Sneak paths - Unexpected paths along which current, energy, or logical sequence flows in an unintended direction;
- Sneak timing - Events occurring in an unexpected or conflicting sequence;
- Sneak indications - Ambiguous or false displays of system operating conditions that may cause the system or operator to take an undesired action;
- Sneak labels - Incorrect or imprecise labeling of system functions (e.g., system inputs, controls, displays, and buses) that may cause an operator to apply an incorrect stimulus to the system.

Figure 10 provides the applicability of SCA process in the product life cycle.

Figure 10. Applicability of SCA Process in Product Life Cycle.

S-102.2.5	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value					
Very-High Unit-Value		Capability Level 1 Activities	Capability Level 3 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value		Capability Level 1 Activities	Capability Level 3 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.9 Design Concern Analysis

Purpose

To assure a safe and reliable product by designing-in special features which prevent, tolerate, or recover from failures, compensate for potential design weaknesses, or mitigate failure risk.

Process Description

Use design rules and guidelines early during design to ensure a degree of product durability by avoiding specific types of design weaknesses. Or, perform an analysis on an existing design to identify where special features are needed to mitigate specific types of design weakness. Some of these special features include redundancy, fault tolerance, fail-safe, and design margin. Figure 11 provides the applicability of DCA process in the product life cycle.

Figure 11. Applicability of DCA Process in Product Life Cycle.

S-102.2.6	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value		Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value		Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value		Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value		Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.10 Finite Element Analysis

Purpose

Finite element methodologies are used to

1. Perform structural stress analysis to identify peak stresses, stress distributions and transmission patterns. This is used to assess the effectiveness of an electronic device's physical packaging to maintain structural and circuit interconnection integrity and a suitable environment for the circuits to function reliably. Analytical evaluations of these physical aspects transform the discipline of electronics packaging from a subjective art into an objective science.
2. Perform thermal stress analysis to determine the response of an electronic device to the thermal stresses anticipated throughout its service life. Thermal analysis predicts the maximum temperature of an electronic module, and the temperature of its individual components, due to internal heating, when subjected to various power and usage loading conditions.

Structural stress analysis is used to compute structural deformations, internal forces, and stresses in circuits. In practice, structural stress analysis can be viewed more abstractly as a method to drive an item's structural design process or prove the soundness of a structural design without a dependence on directly testing it.

Process Description

The contractor will perform structural stress analysis to study and compute deformations, internal forces, and stresses using an appropriate set of physical laws and mathematics to predict the behavior of structures. The structural analysis process will incorporate the fields of mechanics and dynamics as well as applicable failure theories.

Electrical stress evaluations will be performed as part of the electronic analysis process. Physical packaging of electronics involves the ergonomics, mechanical support, electrical connections, power, thermal and environmental management features that sustain the components in an electronic device.

The contractor will perform structural stress analysis to:

1) Identify the loading factors that will stress the device in its intended application.
2) Calculate the device's strength and stress-strain relationships transferred throughout the device.
3) Verify that the strain doesn't exceed material yield points, which could cause imminent failure.
4) Identify items that may be highly or frequently stressed. These items are at risk for damage accumulation wear out types of failure mechanisms and will require long term durability analysis.

The contractor will perform thermal stress analysis to:

1) Predict the maximum temperature of an electronic module, and the temperature of its individual components, due to internal heating, when subjected to various power and usage loading conditions.
2) Identify items that are at risk for early failure due to excessive thermal stresses. These items will require long term durability analysis.

Figure 12. Applicability of Finite Element Analysis Process in Product Life Cycle.

S-102.2.7	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value		Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value		Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value		Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value		Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.11 Worst Case Analysis

Purpose

To ensure that all circuits will perform within specifications over a given lifetime while experiencing the worst possible variations of electrical piece parts and environments.

Process Description

Evaluate circuit performance assuming maximum part parameter variations and extreme operating conditions, e.g., long use life, high temperature, radiation, shock, etc. Each part will be subjected to a worst-case part stress analysis at the anticipated maximum part temperature experienced during product qualification testing and operation. This task will be performed during the preliminary circuit design of all developmental hardware products. Figure 13 provides the applicability of WCA process in the product life cycle.

Figure 13. Applicability of WCA Process in Product Life Cycle.

S-102.2.8	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value		Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value		Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value		Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value		Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.12 Environmental Event / Survivability Analysis

Purpose

To ensure the system will physically survive its natural operating environmental by one or more of the following methods: 1) performing a environmental hazard analysis to verify the probability of environmentally induced damage is non-credible (i.e., < 10^-6), 2) showing proper electromagnetic interference (EMI) margin exists for all components susceptible to anticipated single event upsets (SEUs), 3) using commercial products that meet Federal Communications Commission (FCC) or European Union EMC requirements or MIL-STD-461C requirements, and 4) showing that system functionality will be restored following the occurrence of environmentally induced damage.

Process Description

Identify environmental hazards and develop a mathematical model to estimate the failure rate or hazard rate associated with the natural operating environment. The model will represent: (1) historical failures of similar systems versus operating environments, (2) components susceptible to environment induced damage, (3) environmental damage mitigation features, (4) parts durability, (5) a hazard assessment of the operating environment, and an assessment of the system restoration capability. Figure 14 provides the applicability of Human Error Predictions in the product life cycle.

Figure 14. Applicability of Environmental Event / Survivability Analysis in Product Life Cycle.

S-102.2.10	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.13 Anomaly Detection and Response Analysis

Purpose

To develop identification and response methods for system anomalies or faults which pose an unacceptable risk. Depending on how it is performed, ADR analysis can be used to develop different types of ADR systems. The primary output of ADR analysis are functional failure analysis (FFA) worksheets, which systematically identify the detection and response methods for functional failure modes that require such actions, as defined by FMECA, system tests, test deficiency reports, failure analyses, hazard analyses, or risk assessments.

Process Description

Perform an analysis to design system functions for detecting, verifying, isolating, and responding to a specified set of functional failure modes. The ADR analysis process will include the following tasks:

- Defining ADR system requirements and design criteria which meet the user's needs;
- Establishing ADR analysis technical performance metrics (TPMs);
- Collecting and evaluating engineering information needed to perform the analysis (e.g., signal lists, specs, interface control drawings (ICDs), test data, operational data, schematics, and product FMECA);
- Developing functional failure analysis (FFA) worksheets which define the detection, verification, isolation, and response methods, as applicable, for each identified functional failure mode;
- Validating each FFA worksheet;
- Documenting the ADR analysis.

Figure 15 provides the applicability of ADR Analysis in the product life cycle.

Figure 15. Applicability of ADR Analysis in Product Life Cycle.

S-102.2.11	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.14 Maintainability Predictions

Purpose

To perform probabilistic estimates of failure maintenance times based on maintenance time-study data, diagnostics capability of the design, and accessibility of failed components. Maintainability predictions are performed to aid: 1) defining / meeting repair time requirements, 2) identifying where design features are needed to reduce the repair time, and 3) ensuring all repair actions are characterized and repeatable. The output of maintainability predictions is primarily used to support integrated logistics support (ILS) assessments. This task aids in ensuring maintenance training and skill levels are compatible with system design, and it provides key input to system availability and dependability modeling / predictions.

Process Description

Perform maintainability predictions to support system availability and dependability modeling / predictions, and ILS assessments, as required. Figure 16 provides the applicability of Human Error Predictions in the product life cycle.

Figure 16. Applicability of Maintainability Predictions in Product Life Cycle.

S-102.2.12	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.15 Operational Dependability and Availability Modeling

Purpose

To develop mathematical or simulation models to be used for probabilistic apportionments or predictions of the percentage of total time or number of cycles of system use is expected to occur based on the collective R&M characteristics of all the functional items required for a system to successfully perform its mission or be capable of starting its mission. The primary outputs of D_O/A_O modeling are:

- A probabilistic assessment that the system will be available for service when required, or that it will successfully complete a mission given its availability at the start of the mission;
- A probabilistic assessment that the system will be available for service at a specific instant in time, or that it will in service during a mission at a specific instant in time given its availability at the start of the mission.

Process Description

The contractor will perform Operational Dependability and Availability modeling / predictions using as inputs the system's operational reliability characteristics, based on engineering data that reflects the mission environments and system usage, and the system's maintainability characteristics. Input data used to develop mathematical or simulation D_O/A_O models include the following:

a. System hierarchical functional flow

b. System operating modes and the mission timeline

c. Functional to physical association of each item in the system, to include as a minimum:

   i. All electrical, electronic, and electromechanical (EEE) items that perform essential functions in each specified mission time period or operating cycle, e.g., switches and sensors that control restorable functions

   ii. All mechanical, pneumatic, pyrotechnic~~al~~, and structural items that perform essential functions in each specified mission time period or operating cycle

d. System-level effects due to the loss of each functional item in the system

e. Operational failure rate or hazard rate for each functional item in the system

f. Operational restoration rate for each functional and physical item in the system. (The restoration rate includes the time to restore the item to full operational functionality from the time the item is first taken out of service, whether due to scheduled or unscheduled maintenance).

g. Logistics delay time for each physical item in the system.

The amount of effort required to develop accurate predictions for system-level D_O/A_O is dependent on the complexity of the system, its mission environment, and its usage. Figure 17 provides the applicability of Operational Dependability and Availability Modeling in the product life cycle.

Figure 17. Applicability of Operational Dependability and Availability Modeling in Product Life Cycle.

S-102.2.13 **Product Unit Value**	**Product Life Cycle Phase**				
	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.16 Software Component Reliability Predictions

Purpose
To quantify the probability or frequency of a software component's functional success or failure. Predictions are usually expressed as a statistical life distribution that represents the probability of a software component functioning during a particular time period. This task aids in ensuring software design reliability, and it provides key input to system reliability modeling / predictions.

Process Description
Develop mathematical or simulation models which represent the following software component attributes:

a. Architecture
b. Application
c. Use environment
d. Operating profile
e. Failure modes, mechanisms, and causes

Figure 18 provides the applicability of Software Component Reliability Predictions in the product life cycle.

Figure 18. Applicability of Software Component Reliability Predictions in Product Life Cycle.

S-102.2.15	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities	Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.17 Process Failure Mode, Effects and Criticality Analysis (FMECA)

Purpose

To analyze an operation / process to identify the kinds of errors which are possible in carrying out the documented procedures, the worst case consequences of those errors on the process (and possibility the product), and the probabilities of those consequences occurring. The process FMECA identifies all process weaknesses that pose an unacceptable risk.

Process Description

The contractor will perform a systematic analysis of the in place processes used to manufacture, assemble, test, transport, maintain, and operate the system to identify possible weaknesses or risks, and also evaluate the criticality of each weakness / risk. A process FMECA is prepared whenever a process flow block diagram is available, and should be updated throughout the system development cycle. Figure 19 provides the applicability of Process FMECA in the product life cycle.

Figure 19. Applicability of Product FMECA in Product Life Cycle.

S-102.2.16	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value					
Very-High Unit-Value			Capability Level 3 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value			Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.18 Similarity and Allocations Analysis

Purpose
To extrapolate the performance of unknown parameters of a product based on an assessment of known parameters of a similar product.

Process Description
Select a product that is closely similar to the target product for which knowledge of key performance parameters is desired, and identify the parameters that are similar and dissimilar between the two products. The contractor will use the known performance parameters of the similar product to extrapolate the unknown performance parameters of the target product. Figure 20 provides the applicability of Similarity and Allocations Analysis process in the product life cycle.

Figure 20. Applicability of Similarity and Allocations Analysis Process in Product Life Cycle.

S-102.2.20	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					Capability Level 1 Activities (*)
Medium Unit-Value					Capability Level 2 Activities (*)
High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.19 Stress and Damage Simulation Analysis

Purpose

To determine or predict when a specific end-of-life failure mechanism will occur for an individual part in a specific application. The damage simulation approach of predicting the reliability of electronics systems is founded on the fact that fundamental mechanical, electrical, thermal, and chemical processes govern failure mechanisms. The analysis may be used for accepting a design, if the estimated minimum time to failure is greater than the desired design life; performing a sensitivity analysis which reveals the sensitivity of the package lifetime to the package geometry, material properties, operating conditions, and environmental attributes; altering design parameters, according to sensitivity analysis results, to raise the minimum time to failure to the desired design life; or computing the time to failure for potential failure mechanisms. It can also be used to plan tests or screens, and to determine electrical, mechanical, and environmental stress margins.

Process Description

The contractor will base highly critical component reliability predictions, when sufficient field data is not available, on a scientific determination of the dominant failure mechanisms and failure sites within the part, by characterizing the stresses in the system using models derived from fundamental principles and experiments widely accepted by the scientific community. Figure 21 provides the applicability of Stress and Damage Simulation Analysis process in the product life cycle.

Figure 21. Applicability of Stress and Damage Simulation Analysis Process in Product Life Cycle.

S-102.2.22	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value		Capability Level 2 Activities	Capability Level 3 Activities	Capability Level 3 Activities	Capability Level 3 Activities (*)
Very-High Unit-Value		Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 4 Activities	Capability Level 4 Activities (*)
Ultra-High Unit-Value	Capability Level 1 Activities	Capability Level 2 Activities	Capability Level 4 Activities	Capability Level 5 Activities	Capability Level 5 Activities (*)

(*) indicates that the process capability level activities only apply to changes that occur during that product life cycle phase.

5.3.20 Reliability Development/Growth Testing (RD/GT)

Purpose

To improvement the reliability of an equipment through the systematic and permanent removal of failure mechanisms. Achievement of reliability growth is dependent upon the extent to which testing and other improvement techniques have been used during development and production to "force out" design and fabrication flaws, and on the rigor with which these flaws are analyzed and corrected. The rate at which reliability grows is therefore dependent on how rapidly activities in this iterative loop can be accomplished, how real the identified problems are, and how well the redesign effort solves the identified problems.

Process Description

The contractor will establish a reliability growth program that is the result of an iterative design process. The delivered product is field tested to identify actual sources of failures or analyzed to identify potential sources of failures. Further design effort is then spent on correcting these problem areas. The design effort can be applied to either product design or manufacturing process design. There are three essential elements involved in achieving reliability growth:

(1) Detection of failure sources (by analysis and test)

(2) Feedback of problems identified

(3) Effective redesign effort based on problems identified

Figure 22 provides the applicability of Reliability Development/Growth Testing process in the product life cycle.

Figure 22. Applicability of RD/GT Process in Product Life Cycle.

S-102.3.2	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value					
Very-High Unit-Value					
Ultra-High Unit-Value				Capability Level 4 Activities(**)	Capability Level 5 Activities

(**) indicates that Reliability Life Testing is performed on a prototype, sample, or similar product to that delivered.

5.3.21 Reliability, Maintainability, and Availability Demonstration Testing

Purpose

To conduct field testing to determine conformance to specified, quantitative reliability, maintainability, or availability requirements as a basis for qualification or acceptance. This process is implemented to answer the question, "Does the system meet or exceed (not by how much) the specified minimum reliability requirement?

Process Description

The contractor will plan and implement reliability, maintainability, and availability demonstration (RMAD) test procedures, with respective to accept/reject criteria and measurement parameters, to evaluate the operational reliability, maintainability, or availability of the delivered product. The RMAD test plan will describe how the equipment/system will be tested, the specified test conditions (e.g., environmental conditions), test measurement parameters, length of test, equipment operating conditions, accept/reject criteria, and test reporting requirements. Figure 23 provides the applicability of Reliability, Maintainability, and Availability Demonstration Testing process in the product life cycle.

Figure 23. Applicability of Reliability, Maintainability, and Availability Demonstration Testing Process in Product Life Cycle.

S-102.3.3	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value					
Very-High Unit-Value				Capability Level 3 Activities(**)	Capability Level 4 Activities
Ultra-High Unit-Value				Capability Level 4 Activities(**)	Capability Level 5 Activities

(**) indicates that Reliability Life Testing is performed on a prototype, sample, or similar product to that delivered.

5.3.22 Reliability Life Testing

Purpose

To validate estimates of a product's lifespan. This requirement is suited to long missions, extended usage, or components of unknown lifespan and reliability.

Process Description

Perform tests under operating conditions which are move severe than those expected during the product's useful life to determine its lifespan in accelerated time. Reliability life testing is conducted under accelerated operating conditions to induce failures at a rate and severity indicating that end-of-life has been reached. Figure 24 provides the applicability of Reliability Life Testing process in the product life cycle.

Figure 24. Applicability of Reliability Life Testing Process in Product Life Cycle.

S-102.3.4	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value				Capability Level 2 Activities(**)	Capability Level 3 Activities
Very-High Unit-Value				Capability Level 3 Activities(**)	Capability Level 4 Activities
Ultra-High Unit-Value				Capability Level 4 Activities(**)	Capability Level 5 Activities

(**) indicates that Reliability Life Testing is performed on a prototype, sample, or similar product to that delivered.

5.3.23 Ongoing Reliability Testing

Purpose

To conduct factory testing to determine conformance to specified quantitative reliability requirements as a basis for qualification or acceptance. This process is implemented to answer the question, "Does the development process meet or exceed (not by how much) the specified quality assurance requirement?

Process Description

The purpose of Ongoing Reliability Testing (ORT) is to periodically test samples of the product under nominal conditions, which are similar to those expected during the product's useful life, to ensure the product is reliable at time of delivery. Figure 25 provides the applicability of the Ongoing Reliability Testing process in the product life cycle.

Figure 25. Applicability of Ongoing Reliability Testing Process in Product Life Cycle.

S-102.3.6	Product Life Cycle Phase				
Product Unit Value	Conceptual Design Phase	Preliminary Design Phase	Detailed Design Phase	Fabrication, Assembly, Integration and Test	Delivered Product Operation & Service
Low Unit-Value					
Medium Unit-Value					
High Unit-Value					
Very-High Unit-Value					
Ultra-High Unit-Value				Capability Level 4 Activities(**)	Capability Level 5 Activities

(**) indicates that Reliability Life Testing is performed on a prototype, sample, or similar product to that delivered.

5.4 Coordinate the RMAD Processes with Other Systems Engineering Processes

The RMAD process manager or his/her representative will participate in program design reviews, technical interchange meetings, management status reviews, working group meetings, and any other meetings held by the program that may be germane to RMAD.

5.4.1 Oversee Subcontractor's RMAD Activities

SET will oversee the RMAD activities of subcontractors during product manufacture, test, inspection, and shipping. If a Capability Level 3 or higher RMAD process is required, SET will require major subcontractors to provide RMAD data products in predefined formats that facilitate integrating these data products with assembly, subsystem, or system level analyses, tests, or inspections.

5.4.2 Establish, Utilize, and Maintain a Project RMAD Database System

If a Capability Level 3 or higher RMAD process is required, SET will establish, utilize, and maintain an integrated program-wide RMAD Database System that: (1) provides seamless interfaces among mission assurance processes and systems engineering functions, such as, Design, Manufacturing, and Test; (2) contains all the key RMAD requirements and data products; (3) has data change control and tracking procedures; (4) can automatically generate RMAD Program plans and reports that are commensurate with the end product's unit value/criticality, systems engineering process, and applications, and (5) can automatically evaluate RMAD Program plans and reports with regard to measure of compliance with requirements and appropriateness of verification artifacts.

SET will assure timely utilization of the RMAD Database System to the greatest extent practical by Systems Engineering functions, such as, Design, Manufacturing, Test, and Risk Management. The RMAD Database System will aid in coordinating the assessment of broad categories of system deficiencies as part of the overall RMAD effort. The exchange of RMAD data products among Systems Engineering functions will be governed by approved systems engineering data flow plans. SET will make every effort to avoid duplication of effort whenever possible.

If a Capability Level 4 or higher MAP is required, all data that are entered in or extracted from the Project RMAD Database System will be referenced with one or more keyword data element descriptions (DED), which are listed in the last Annex sections of the AIAA S-102 Standards. Each keyword DED belongs to one of the following data types:

- Physical or Functional Characteristic
- Physical or Functional Dependency
- Application
- Failure Mode and Effects Analysis (FMEA) / Hazard Analysis
- Criticality Analysis[3]
- Anomaly Detection, Isolation and Response (ADR)
- Safety, Reliability, or Maintainability Critical Item

[3] Hazard rate data, constant failure rate data, and probability of occurrence data all fall under Criticality Analysis DEDs.

- Failure / Hazard Compensation
- Identification
- Unit
- Reference
- Event
- Diagnostic
- Value
- Comment
- Attachment
- Database Administration

5.5 Apply Engineering and Evaluation Methods to Identify System and Process Deficiencies

SET will apply validated engineering and evaluation principles and techniques to identify existing and potential system and process deficiencies, including unacceptable design weaknesses as defined in section 5.3.1. SET will also identify practical methods for avoiding, eliminating, or controlling unacceptable design weaknesses, and for verifying that the implemented mitigation/disposition methods are successful.

The prerequisite for performing a thorough and accurate failure mode, effects, and criticality analysis, or hazard analysis (FMECA/Hazard Analysis), is to first understand how the system operates and its mission success criteria. SET will ensure that the project's SR&QA engineers are provided with detailed and comprehensive functional diagram models of the system at all indenture levels of the system.

SET and customer will mutually establish the unacceptable design criteria. The unacceptable design criteria will be based on studies, analyses, historical data, and test data. The RMAD process will use these criteria to further evaluate requirements and designs to see if they are acceptable.

5.5.1 Define the System Failure Criteria and Identify Failure Modes

SET will define the system failure criteria. If a Capability Level 2 or above RMAD process is required, the contractor shall document the failure criteria in the RMAD program plan. A severity category will be assigned to each identified failure mode or hazard based on the worst case end effects on the system or mission, and the probability of occurrence will be estimated as either a quantitative or qualitative value. Qualitative probability values will follow the same ground rules as qualitative severity categories. They will be defined in sufficient detail to allow different people to independently arrive at the same conclusion when reviewing the same data. The definitions in Table 1, for failure mode severity and probability of occurrence categories, will be used in all mission assurance analyses, evaluations, and tests.

In the absence of a quantitative probability of occurrence analysis, the selection of a qualitative probability value that is based solely on an engineering judgment or guess may be necessary. For all cases where engineering judgment is used in high or serious residual risk acceptance decisions, the

source(s) of the engineering judgment will be identified and verified to have several years of experience in performing detailed reliability predictions on systems, equipment, or processes similar to the one being assessed.

Table 2. Failure Mode Severity and Probability of Occurrence Category Definitions

Value/ Level	Occurrence		Severity		
	Reliability Definitions	System Safety Definitions	Reliability Definitions		System Safety Definitions
5	Very High (1 in 10 or greater)	(A) FREQUENT (X > 10^-1)	1 - Complete loss of mission: complete loss of primary mission capability.		I - 1 - CATASTROPHIC Death, system loss, or severe environmental damage.
4	High (less than 1 in 10 but greater than 1 in 20)	(B) PROBABLE (10^-1 > X > 10^-2)	2 - Major loss or degradation of the primary mission: capability to complete some mission objectives (or all at a degraded level) with immediate loss of a critical science instrument; or loss of a major amount of critical science data; or major reduction in life of the primary mission; or loss of spacecraft function resulting in loss of opportunity for obtaining critical science data.		II - 2 - CRITICAL Severe injury, severe occupational illness, major system or environmental damage.
3	Moderate (less than 1 in 20 but greater than 1 in 100)	(C) OCCASIONAL (10^-2 > X > 10^-3)	3 - Minor loss or degradation of the primary mission: minor loss of spacecraft or instrument function leading to loss of a minor amount of critical science data; or a significant reduction in life of the primary mission; or loss or major degradation of an ancillary mission.	1R - Loss or degradation of a redundant subsystem or science instrument producing level 5 severity, if remaining redundancy is lost.	III - 3 - MARGINAL / SIGNIFICANT Minor injury, minor occupational illness, or minor system or environmental damage.
2	Low (less than 1 in 100 but greater than 1 in 500)	(D) REMOTE (10^-3 > X > 10^-6)	4 - Potential for less than minor loss or degradation of spacecraft or performance: no immediate impact on spacecraft or primary mission, but potential exists for future loss, at severity levels 3 to 5, due to induced failure or resulting from the conjunction of this anomaly with a future event; or potential for cumulative major loss of a mission-critical function over a long period of time; or spacecraft or primary mission loss or significant degradation, at severity level 4, would occur if adequate redundancy, alternatives, or compensating measures are not implemented; or minor degradation of an ancillary mission.	2R - Loss or degradation of a redundant subsystem or science instrument, producing a level 4 severity, if remaining redundancy is lost.	IV - 4 - NEGLIGIBLE Less than minor injury, occupational illness, or less than minor system or environmental damage.
1	Very Low (less than 1 in 500)	(E) IMPROBABLE / NON-CREDIBLE (10^-6 > X)	5 - Insignificant or no impact on spacecraft life or performance: barely noticeable or no performance degradation, and fault does not lead to loss or degradation of instrument data; or loss of significant amount ofancillary mission data; or significant peril to spacecraft or primary mission, at severity level 3, would occur if adequate redundancy, alternatives, or compensating measures are not implemented; or less than minor degradation of an ancillary mission.	3R - Loss or degradation of a redundant subsystem or science instrument, producing a level 3 severity, if remaining redundancy is lost.	V - 5 - NONE / INSIGNIFICANT Failure modes that would have no loss or effects to mission objectives or the environment, or no injuries.

5.5.2 Assess Maturity of Key Input Data, Constraints, Ground Rules, and Analytical Assumptions

If a Capability Level 4 or higher RMAD process is required, SET will identify each key input data and its known/anticipated sources, and describe how the maturity of key input data, such as, analytical assumptions, constraints, and ground rules used in the performance of mission assurance processes, will be assessed in accordance with the Table 2 criteria.

Table 3. Key Input Data, Constraints, Ground Rules, and Analytical Assumptions Maturity Ratings

HIGH	MEDIUM -TO-HIGH	MEDIUM	LOW-TO-MEDIUM	NEGLIGIBLE–TO-LOW
Based on statistically significant field data	Based on statistically significant test data	Based on simulation model	Based on extrapolated field or test data	Based on engineering judgment or guess

5.6 Risk Assessment and Control

5.6.1 Integrate RMAD Process with Program-wide Risk Management Process

SET will integrate the mission assurance processes with the program-wide risk management process. Each identified unacceptable risk will be analyzed, and mitigated or controlled and tracked throughout the systems engineering life cycle. SR&QA risks will be assessed in respect to severity of effects and likelihood of occurrence. All high and serious residual risks will be accepted by the appropriate authority. At a minimum, risk mitigation activities will include:

- Establishing the minimum qualifications required to perform each RMAD process;
- Identifying and reporting instances of significant residual risk to management;
- Managing safety-critical and mission-critical items;
- Monitoring the mission assurance processes to ensure they are performed in accordance with the Integrated Master Schedule (IMS) and the project budget;
- Determining the appropriate responses to unplanned events for each RMAD process.

In selecting specific fault mitigation or control methods, SET will apply the following fault disposition method order of precedence. The order in which different methods will be considered in the disposition of unacceptable faults will be the following:

- Eliminate faults through design selection. Ideally, the risk of a failure mode should be eliminated. This elimination is often accomplished by selecting a design alternative that removes the fault altogether;
- Reduce risk through design alteration. If the risk of a failure mode cannot be eliminated by adopting an alternative design or alternative material, consider design changes that reduce the severity and/or the probability of a failure mode;
- Incorporate engineered features or devices. If the risk of a failure mode is unable to be eliminated or adequately mitigated through a design alteration, reduce the risk using an engineered feature or device. In general, engineered features actively interrupt the failure mechanism sequence and devices reduce the risk of a failure mode;

- Provide warning devices. If engineered features and devices do not adequately lower the risk of the failure mode, include a detection and warning system to alert personnel to the presence of a faulty condition or occurrence of a undesirable latent event.
- Develop procedures and training. Where other risk reduction methods cannot adequately mitigate the risk from a failure mode, incorporate special procedures and training. Procedures may prescribe the collection of diagnostics or prognostics data. Warnings, cautions, and other written advisories will not be used as the only risk reduction method for high and serious initial risk levels.

SET will use the 5x5 risk matrix to assess RMAD risks. SET will present all high and serious hazard risks identified using the MIL-STD-882 system safety methodology in the format of the translation table shown in Figure 11.

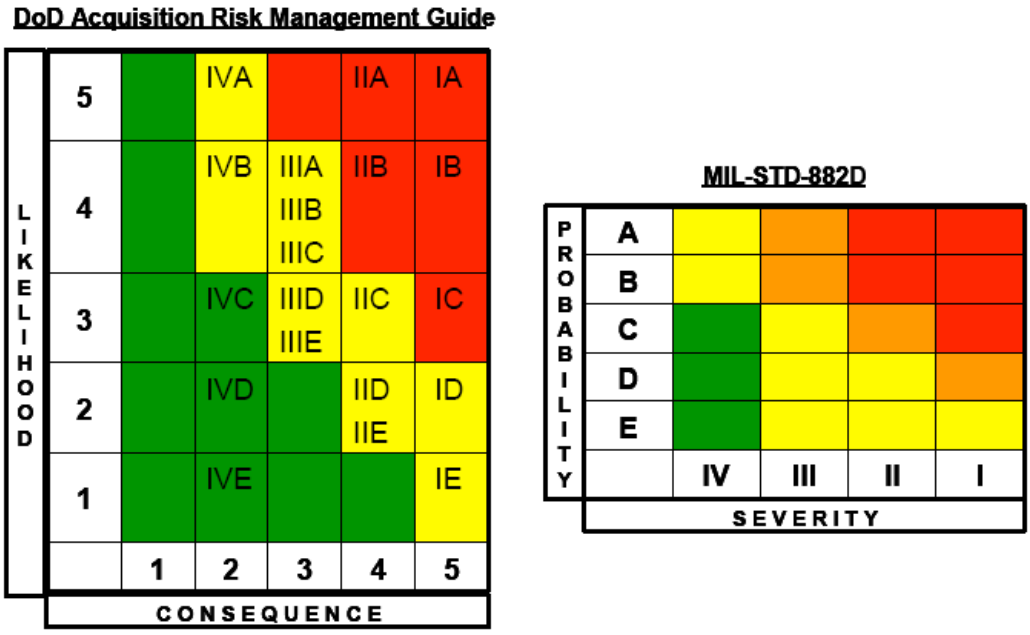

Figure 11. Translation of MIL-STD-882D Risk Matrix to the OSD Risk Management Guide Matrix

5.6.2 Perform Structured Reviews

If a Capability Level 5 or higher RMAD process is required, SET shall develop and apply a structured review process (e.g., a formal peer review working group) to aid thorough evaluation of the RMAD data products in all product life cycle phases. The review process will include personnel who are cognizant of events that led to failures in systems similar to the one being developed. Product-based and process-based lessons learned that are relevant to the system being developed will be gathered across the enterprise and used to develop review checklists that support timely implementation of the structured review process and updating of the RMAD Program. The review checklists will reflect the technical knowledge, insights, design rules, application data, and other clues that helped uncover latent deficiencies.

The types of systems engineering artifacts that should be independently reviewed will include, but are not limited to, those listed in Table 3.

Table 4. Sample Systems Engineering Artifacts.

NAME OF DOCUMENT	ARTIFACT CATEGORY
Acquisition Strategy Document (ASD)	Planning
Anomaly Detection and Resolution (ADR) Design Description	Engineering & Evaluation
Approved Parts & Materials List (APML)	Program Coordination
Command Media (Contractor's Lessons Learned Approval Process)	Program Authorization
Command Media (Contractor's Quality Assurance Program)	Program Authorization
Command Media (Contractor's SR&QA Programs)	Program Authorization
Critical Item List (CIL)	Engineering & Evaluation
End-Of-Life Plan (EOLP)	Planning
Environmental Analysis Data Report	Engineering & Evaluation
Failure Mode, Effects and Criticality Analysis (FMECA)	Engineering & Evaluation
Fault Tree Analysis (FTA)	Engineering & Evaluation
Failure Report	Engineering & Evaluation
FRACAS Plan (with post mission anomaly data collection section)	Planning
Hazard Report (HR)	Engineering & Evaluation
Hazard Risk Assessment Matrix (HRAM)	Risk Tracking
Hazardous Material Management Program (HMMP) Report	Planning
Indentured Parts List	Program Coordination
Integrated Master Plan (IMP)	Planning
Integrated Master Schedule (IMS) (Contractor's SR&QA Programs)	Planning
Mishap Investigation Plan (MIP)	Planning

NAME OF DOCUMENT	ARTIFACT CATEGORY
Mishap Risk Assessment Report (MRAR)	Engineering & Evaluation
Missile System Pre-launch Safety Packages (MSPSP)	Engineering & Evaluation
NEPA Facilitation Report	Engineering & Evaluation
On-orbit Operations Handbook (OOH)	Program Coordination
Operational Dependability Analysis	Engineering & Evaluation
Operational Requirements Document (ORD)	Requirements
Orbital/Launch Anomaly Summary Reports/Databases	Engineering & Evaluation
Part Stress Derating Analysis	Engineering & Evaluation
Parts, Materials, and Processes (PMP) Program Plan	Planning
Preliminary Hazard Analysis (PHA)	Engineering & Evaluation
Preliminary Hazard List (PHL)	Engineering & Evaluation
Programmatic Environment, Safety, & Operational Health Evaluation (PESHE)	Risk Tracking
Quality Assurance (QA) Program Plan	Planning
Reliability Life Test Plan	Planning
Request for Proposal	Requirements
Risk Management/Mitigation Process Plan	Planning
Risk Management/Mitigation Process Air Force Instruction	Planning
Safety Assessment Report (SAR)	Engineering & Evaluation
Space Debris Assessment Report (SDAR), aka, Orbital Debris Assessment Report (ODAR)	Engineering & Evaluation
Space Vehicle Survivability Analysis	Engineering & Evaluation
Statement of Work (SOW)	Requirements
Subsystem Hazard Analysis (SSHA)	Engineering & Evaluation
System Hazard Analysis (SHA)	Engineering & Evaluation
System Reliability Assessment Report	Engineering & Evaluation

NAME OF DOCUMENT	ARTIFACT CATEGORY
System Safety Group (SSG) Charter	Program Authorization
System Safety Group (SSG) Meeting Agenda/Briefing Charts/Minutes/Action Items	Program Coordination
SR&QA Lessons Learned	Program Coordination
SR&QA Program Plan	Planning
SR&QA Status Report	Program Coordination
SR&QA Working Group Meeting Agenda/Briefing Charts/Minutes/Action Items	Program Coordination
System Specification	Program Coordination
Systems Engineering Plan (SEP)	Planning
Test Plan	Planning
Test Report	Verification
Waivers	Risk Tracking

Each of the system safety program artifacts shall be evaluated with respect to the categories and evaluation criteria in Table 4:

Table 5. RMAD Program Artifact Evaluation Criteria.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
Program Authorization	1	The contractor has an industry acknowledged basis for authorizing its RMAD Program.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.3 (e) MIL-STD-1543B (f) MIL-STD-785B (g) MIL-STD-470B (Tailored) **OUTPUTS:** (a) Customer's Statement of Work (SOW) (b) Contractor's proposal and subcontractor RFP/SOW (c) Contractor's Internal RMAD Program Command Media (d) RMAD Program Plan and R&M Working Group (RMWG) charter	(a) Output document references specific excerpts from AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, AIAA Standard S-102.1.3, MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), or MIL-STD-470B (Tailored) as basis for authorization of the RMAD Program. (b) RMAD Program authorization includes the contractor's recognition of specific organizations, managers, staff, working groups, procedures, and responsibilities.
	1	The contractor has an industry acknowledged basis for establishing the minimum qualifications of the Lead Reliability Engineer.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.3 (e) MIL-STD-1543B (f) MIL-STD-785B **OUTPUTS:** (a) Customer's Statement of Work (SOW) (b) Contractor's proposal and subcontractor RFP/SOW (c) Contractor's Internal RMAD Program Command Media (d) RMAD Program Plan and R&M Working Group (RMWG) charter	(a) Output document references specific excerpts from AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, AIAA Standard S-102.1.3, MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), or MIL-STD-470B (Tailored) as basis for establishing the Lead Reliability Engineer's minimum qualifications. (b) Lead Reliability Engineer's qualifications include minimum college degrees and minimum years of directly related experience. (c) Lead Reliability Engineer should have the skills to write the R&M Program Plan, oversee subcontract R&M activities, and chair the RMWG.
	2	The contractor has an industry acknowledged basis for establishing empowering policies that facilitate effective execution of the RMAD Program.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.3 (e) MIL-STD-1543B (f) MIL-STD-785B (g) MIL-STD-470B (Tailored) **OUTPUTS:** (a) Customer's Statement of Work (SOW) (b) Contractor's proposal and subcontractor RFP/SOW (c) Contractor's Internal RMAD Program Command Media (d) RMAD Program Plan and R&M Working Group (RMWG) charter	(a) Output document describes specific excerpts from AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, AIAA Standard S-102.1.3, MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), or MIL-STD-470B (Tailored) as basis for empowering the Lead Reliability Engineer with the power to effectively execute the RMAD Program. (b) Lead Reliability Engineer should be empowered to report R&M risks directly to the project director, coordinate all of the R&M related activities that are performed by internal disciplines, and oversee the R&M activities of subcontractors.
	3	The contractor has an industry acknowledged basis for acquiring resources to facilitate cost-effective execution of the RMAD Program.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1	(a) The output document describes specific excerpts from AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, AIAA

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
			(c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.3 (e) MIL-STD-1543B (f) MIL-STD-785B (g) MIL-STD-470B (Tailored) **OUTPUTS:** (a) Customer's Statement of Work (SOW) (b) Contractor's proposal and subcontractor RFP/SOW (c) Contractor's Internal RMAD Program Command Media (d) RMAD Program Plan and R&M Working Group (RMWG) charter	Standard S-102.1.3, MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), or MIL-STD-470B (Tailored) as basis for acquiring resources to facilitate cost-effective execution of the RMAD Program. (b) RMAD Program resources include the project-wide parts engineering database, and R&M design checklists to be used by all R&M stakeholders in the project.
	4 & 5	The contractor has an industry acknowledged basis for interfacing with outside industry organizations and working groups whose charter/goal is to optimize the effectiveness of industry acknowledged quality assurance methods.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.3 **OUTPUTS:** (a) Memorandum of Understanding (b) Contractor's Internal RMAD Program Command Media	(a) Output document describes specific excerpts from AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, or AIAA Standard S-102.1.3 as basis for interfacing with outside industry organizations and working groups whose charter/goal is to maximize the effectiveness and minimize the risk of industry recognized R&M engineering methods. (b) The types of information to be exchanged with outside industry organizations include non-proprietary lessons learned, FMECA reports, component reliability models, and open source computerized tool models.
Requirements Definition	1	All of the applicable reliability and maintainability (R&M) requirements and self-imposed objectives are identified by the Lead Reliability Engineer.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) MIL-STD-1543B (e) MIL-STD-785B (f) MIL-STD-470B (Tailored) (g) Customer's Statement of Work (SOW) (h) Contractor's proposal and subcontractor RFP/SOW (i) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) R&M requirement verification plan (RVP)	(a) The RMAD program general requirements are identified in AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.1.2. (b) The RMAD program specific requirements are identified in MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), or the SOW. (c) All RMAD program specific requirements and their sources are supposed to be included in the Requirements vs. Tasks Matrix in the RMAD Program Plan. (d) Each discipline is supposed to have a similar matrix in their respective Plan to identify the tasks that will be performed to achieve their particular R&M requirements.
	1	All mission critical items and procedures are required to be identified and actively controlled.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.6 (e) AIAA Standard S-102.1.8 (f) AIAA Standard S-102.2.4 (g) AIAA Standard S-102.2.16 (h) Customer's Statement of Work (SOW) (i) Contractor's proposal and subcontractor	(a) The mission critical item risk management general requirements are identified in AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, AIAA Standard S-102.1.6, and AIAA Standard S-102.1.8. (b) The required process for identifying mission critical items and procedures is found in AIAA Standard S-102.2.4 and AIAA Standard S-102.1.16. (c) The contractor's WBS establishes active control

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
			RFP/SOW (j) Contractor's Internal RMAD Program Command Media (k) Systems Engineering Management Plan (l) Integrated Master Plan **OUTPUTS:** (a) Work Breakdown Structure (b) Quality Assurance Program Plan (QAPP)	over all mission critical items and procedures. (d) All identified mission critical item are required to be documented in the FMECA and the Critical Items List (CIL).
	1	The applicable reliability design requirements are incorporated in all program documents that impact product reliability.	**INPUTS:** (a) AIAA Standard S-102.2.6 (b) MIL-STD-1543B (c) MIL-STD-785B (d) MIL-STD-470B (Tailored) (e) Customer's Statement of Work (SOW) (f) Contractor's proposal and subcontractor RFP/SOW (g) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Individual Systems Engineering Discipline Plans (c) Product specifications	(a) The reliability design general requirements are identified in AIAA Standard S-102.2.6. (b) The program specific reliability design requirements are identified in MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), or SOW. (c) All of the reliability design requirements and their sources are supposed to be included in the Requirements vs. Tasks Matrix in the RMAD Program Plan. (d) RMAD Program Plan includes a requirement versus responsible discipline matrix that identifies all of the reliability design requirements that other disciplines in Systems Engineering have. Each discipline is supposed to have a similar matrix in their respective Plan. These Plans are supposed to identify the tasks that will be performed to achieve the reliability design requirements. (e) The reliability design requirements are supposed to be identified in the draft requirement verification plan (RVP).
	1	All of the required deliverables are identified, along with the required reporting format for each one.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) MIL-STD-1543B (d) MIL-STD-785B (e) MIL-STD-470B (Tailored) (f) Customer's Statement of Work (SOW) (g) Contractor's proposal and subcontractor RFP/SOW (h) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Individual Systems Engineering Discipline Plans	(a) The required generic deliverables are identified in AIAA Standard S-102.0.1 and AIAA Standard S-102.1.1. (b) The program specific deliverables are identified in MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), the SOW, or the contractor's subcontractor RFP/SOW, along with their required reporting formats. (c) All of the required deliverables and their sources are supposed to be identified in the Requirements vs. Tasks Matrix in the RMAD Program Plan. (d) The RMAD Program Plan includes a required deliverable versus responsible discipline matrix that identifies all of the required deliverables that other disciplines in Systems Engineering have. Each discipline is supposed to have a similar matrix in their respective Plan that identifies the tasks they will perform to complete their deliverable.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
	2	All applicable R&M requirements are flowed down to internal stakeholders and subcontractors.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.3 (e) MIL-STD-1543B (f) MIL-STD-785B (g) MIL-STD-470B (Tailored) (h) Customer's Statement of Work (SOW) (i) Contractor's proposal and subcontractor RFP/SOW (j) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Individual Systems Engineering Discipline Plans (c) Subcontractor SOW (d) Subcontractor SSPP	(a) The flow-down requirements for R&M requirements are identified in AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, and AIAA Standard S-102.1.3. (b) The program specific flow-down requirements for R&M requirements are identified in MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), the SOW, or the contractor's subcontractor RFP/SOW. (c) All of the internal R&M stakeholders and subcontractors with R&M requirements are supposed to be identified in the RMAD Program Plan, along with their flowed down R&M requirements. (d) The subcontractor SOW identifies the flowed down R&M requirements. (e) Each subcontractor's RMAD Program Plan is supposed to identify the tasks needed to meet their flowed down R&M requirements.
	3	The use of industry acknowledged reliability engineering methods is required of all systems engineering disciplines that perform reliability engineering/analytical tasks.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Individual Systems Engineering Discipline Plans (c) Systems Engineering Discipline Engineering and Evaluation Reports	(a) The industry acknowledged requirements for generic R&M methods are identified in AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.1.2. (b) Contractor's internal RMAD Program Command Media requires all systems engineering disciplines to use industry acknowledged analytical methods. (c) The RMAD Program Plan and Systems Engineering Discipline Plans and Reports are supposed to identify their analytical methods and the references to industry acknowledgements.
	3	Overlooked, unnecessary, or incorrect R&M requirements are identified by using Decision Analysis, Mission Analysis, and Requirements Hazard Analysis, or equivalent methods.	**INPUTS:** (a) AIAA Standard S-102.2.14 (b) Decision Analysis Guide (c) Mission Analysis Guide **OUTPUTS:** (a) Requirements Hazard Analysis Report (b) Risk Management Database Report	(a) The overlooked, unnecessary, or incorrect R&M requirements are uncovered using approaches found in AIAA Standard S-102.2.14, Decision Analysis Guide, or Mission Analysis Guide. (b) Overlooked, unnecessary, or incorrect R&M requirements are supposed to be identified in the contractor's Requirements Hazard Analysis Report, and Risk Management Database Report.
	3	Approved waivers are provided for all unmet reliability design requirements.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) SEMP (c) IMP (d) Systems Engineering Discipline Engineering and Evaluation Reports (e) Requirement Verification Report **OUTPUTS:** (a) Approved Waiver Reports (b) Risk Management Database Reports	(a) The requirement for an approved waiver to be provided for each unmet reliability design requirement is found in AIAA Standard S-102.0.1. (b) The requirement for an approved waiver to be provided for each unmet reliability design requirement is supposed to be called out in the SEMP and the IMP. (c) Collectively, the Systems Engineering Discipline Engineering and Evaluation Reports should identify all unmet design reliability requirements that are waived.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
				(d) Approved Waiver Reports document the contractors rational for not meeting a reliability design requirement. (e) The Risk Management Database is supposed to document and track all unmet reliability design requirements.
	4 & 5	Criteria and frequency for RMAD Program self-inspections, and subcontractor proposal evaluations and audits are established.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) MIL-STD-1543B (Tailored) (c) MIL-STD-785B (Tailored) (d) MIL-STD-470B (Tailored) **OUTPUTS:** (a) RMAD Program Plan	(a) General requirements for RMAD Program self-inspections, and subcontractor proposal evaluations and audits are found in AIAA Standard S-102.0.1. (b) Specific requirements for RMAD Program self-inspections and audits are found in MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), or SOW. (c) The contractor's RMAD Command Media defines the criteria for RMAD Program self-inspections, subcontractor proposal evaluations, and subcontractor audits. (d) The contractor's RMAD Program Plan is supposed to identify the frequency and source of criteria for conducting RMAD Program self-inspections, subcontractor proposal evaluations, and subcontractor audits.
	4 & 5	The identification of analytical assumptions that are used in reliability engineering/analytical tasks is required of all systems engineering disciplines.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Individual Systems Engineering Discipline Plans	(a) Requirement for identification of analytical assumptions that are used in reliability engineering/analytical tasks is found in AIAA Standard S-102.0.1. (b) Contractor's Internal RMAD Program Command Media requires all systems engineering disciplines to identify their analytical assumptions (c) Contractor's RMAD Program Plan and Plans generated by other systems engineering disciplines are supposed to reference source of requirement to identify their analytical assumptions.
	4 & 5	RMAD Program defines the standardized data format requirements for maintaining and exchanging R&M data, including R&M deliverables.	**INPUT:** (a) AIAA Standard S-102.1.7 (b) MIL-STD-1543B (Tailored) DIDs (c) MIL-STD-785B (Tailored) DIDs (d) MIL-STD-470B (Tailored) DIDs (e) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Database	(a) General requirements for standardized data formats used in maintaining and exchanging R&M data are found in AIAA Standard S-102.1.7. (b) MIL-STD-1543B (Tailored) DIDs, MIL-STD-785B (Tailored) DIDs, and MIL-STD-470B (Tailored) DIDs define program specific data formats requirements for R&M deliverables. (c) Contractor's internal RMAD Program Command Media defines required formats for maintaining and exchanging R&M data, including R&M deliverables. (d) The structure and contents of the RMAD Program Database are based on the R&M data format requirements.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
Planning (Including Test Plans)	1	All applicable R&M requirements (including customer requirements and self-imposed objectives) that must be achieved by reliability engineering are identified in the RMAD Program Plan.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.3 (e) MIL-STD-1543B (Tailored) (f) MIL-STD-785B (Tailored) (g) MIL-STD-470B (Tailored) (h) Customer's Statement of Work (SOW) (i) Contractor's proposal and subcontractor RFP/SOW (j) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter	(a) The general R&M requirements are identified in AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, and AIAA Standard S-102.1.3. (b) The program specific R&M requirements are identified in MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), the SOW, or the contractor's subcontractor RFP/SOW. (c) The RMAD Program Plan should include a requirement versus task description matrix that identifies all of the tasks that reliability engineering will perform to achieve the RMAD program requirements.
	1	All applicable R&M requirements that must be achieved by other disciplines, e.g., safety design probability of failure (POF) predictions, are identified in the respective Plans of those disciplines and in the RMAD Program Plan. NOTE: The Plans of other disciplines include the Systems Engineering Management Plan, and the Integrate Master Plan, and the Risk Management Plan.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.1.2 (d) AIAA Standard S-102.1.3 (e) MIL-STD-1543B (Tailored) (f) MIL-STD-785B (Tailored) (g) MIL-STD-470B (Tailored) (h) Customer's Statement of Work (SOW) (i) Contractor's proposal and subcontractor RFP/SOW (j) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Individual Systems Engineering Discipline Plans	(a) The general R&M requirements are identified in AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.1.2, and AIAA Standard S-102.1.3. (b) The program specific R&M requirements are identified in MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), the SOW, or the contractor's subcontractor RFP/SOW. (c) RMAD Program Plan includes a requirement versus responsible discipline matrix that identifies all of the reliability design requirements that other disciplines in Systems Engineering are responsible for achieving. (d) Each responsible discipline is supposed to have a requirement versus task description matrix in their respective Plan that identifies the tasks they will perform to achieve their reliability design requirements.
	2	The selection of the measureable and level-of-effort (LOE) RMAD Program tasks are based on: (1) comprehensive coverage of the reliability requirements and self-imposed objectives, (2) optimized balance among reliability cost, schedule, and performance, and (3) the applicable system life cycle phases.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) MIL-STD-1543B (Tailored) (d) MIL-STD-785B (Tailored) (e) MIL-STD-470B (Tailored) (f) Work Breakdown Structure (WBS) (g) Customer's Statement of Work (SOW) (h) Contractor's proposal and subcontractor RFP/SOW (i) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Integrated Master Plane (IMP) (c) Integrated Master Schedule (IMS)	(a) The capability ratings for specific groups of RMAD processes are defined in AIAA Standard S-102.0.1 and AIAA Standard S-102.1.1 (b) The program specific RMAD tasks are identified in MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), the SOW, or the contractor's subcontractor RFP/SOW. (c) The contractor's internal RMAD Program Command Media should include a product unit-value/criticality versus RMAD Program capability level matrix. (d) The contractor's internal RMAD Program Command Media also should include a product life cycle versus RMAD Program capability level matrix. (e) All RMAD activities that can be "notionally" scheduled should be included in the Integrated

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
			(d) RMAD Program Budget Plan	Master Schedule (IMS). The rest of the activities should be allocated a fixed number of hours (i.e., Level of Effort) based on "estimated/anticipated" project support needs.
	2	All of the contractor's RMAD tasks that are performed across the applicable systems engineering life cycle phases are identified in the RMAD Program Plan and the Integrated Master Schedule (IMS), along with their key input/output artifacts.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.2 (c) MIL-STD-1543B (Tailored) (d) MIL-STD-785B (Tailored) (e) MIL-STD-470B (Tailored) (f) Customer's Statement of Work (SOW) (g) Contractor's proposal and subcontractor RFP/SOW (h) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Integrated Master Plan (IMS)	(a) The capability level groups of general RMAD processes are defined in AIAA Standard S-102.0.1 and AIAA Standard S-102.1.1 (b) The contractor's internal RMAD Program Command Media should include a product unit-value/criticality versus RMAD Program capability level matrix. (c) The contractor's internal RMAD Program Command Media also should include a product life cycle versus RMAD Program capability level matrix. (d) The contractor's internal RMAD Program Command Media and RMAD Program Plan should include a RMAD process activity versus generic input/output artifacts matrix. (e) The contractor's RMAD Program Plan should include a RMAD process tasks versus specific input/output artifacts matrix. (f) The contractor's IMS should identify all scheduled RMAD process tasks and specific input/output artifacts.
	2	All subcontractor key RMAD data products/deliverables are identified in the RMAD Program Plan, Systems Engineering Management Plan (SEMP), Integrated Master Plan (IMP), and Integrated Master Schedule (IMS).	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.2 (c) MIL-STD-1543B (Tailored) (d) MIL-STD-785B (Tailored) (e) MIL-STD-470B (Tailored) (f) Customer's Statement of Work (SOW) (g) Contractor's proposal and subcontractor RFP/SOW (h) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Systems Engineering Management Plan (SEMP) (c) Integrated Master Plan (IMP) (d) Integrated Master Schedule (IMS)	(a) The subcontractor's generic RMAD data products/deliverables are identified in AIAA Standard S-102.1.3. (b) The contractor's internal RMAD Program Command Media also should identify the subcontractor's generic RMAD data products/deliverables. (c) The RMAD Program Plan should identify the subcontractor's specific RMAD data products/deliverables and their respective required delivery dates. (d) The SEMP, IMP, and IMS also should identify the subcontractor's RMAD data products/deliverables.
	2	All scheduled and level of effort (LOE) RMAD tasks are adequately funded.	**INPUTS:** (a) Contractor's Internal RMAD Program Command Media (b) RMAD Program Plan and R&M Working Group (RMWG) charter (c) Individual Systems Engineering Discipline Plans **OUTPUTS:** (a) Integrated Master Schedule (IMS) (b) RMAD Program Budget Plan	(a) The contractor's internal RMAD Program Command Media should describe methods for estimating the rough order of magnitude (ROM) of hours needed to complete specific RMAD tasks. (b) The RMAD Program Plan identifies all scheduled and LOE RMAD tasks. (c) The rationale for the fixed hours allotted for each scheduled or LOE task is documented in the RMAD Program Budget Plan.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
				(d) The amount of time allotted to complete each scheduled RMAD task is identified in the IMS.
	3	The use of industry-acknowledged engineering/analytical methods is called out in the Plan of each discipline that is responsible for performing or supporting an RMAD engineering/analytical task.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Individual Systems Engineering Discipline Plans	(a) AIAA Standard S-102.0.1 and AIAA Standard S-102.1.1 call for each discipline that is responsible for performing or supporting an RMAD engineering/analytical task to use industry-acknowledged engineering/analytical methods. (b) The Contractor's Internal RMAD Program Command Media should call for each discipline that is responsible for performing or supporting an RMAD engineering/analytical task to use industry-acknowledged engineering/analytical methods. (c) The RMAD Program Plan should call for each discipline that is responsible for performing or supporting an RMAD engineering/analytical task to use industry-acknowledged engineering/analytical methods. (d) The Plans of individual systems engineering disciplines should call for performing their respective RMAD engineering/analytical tasks using industry-acknowledged methods.
	4 & 5	A plan is developed and implemented to improve the reliability design of the operational system over time.	**INPUTS:** (a) AIAA Standard S-102.3.2 (b) Customer's Statement of Work (SOW) (c) Contractor's proposal and subcontractor RFP/SOW (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Product Reliability Growth Plan (c) FRACAS Plan (d) FRB Charter	(a) The general requirements for Reliability Development/Growth Testing (RD/GT) are defined in AIAA Standard S-102.3.2. (b) The general requirements and activities for Reliability Development/Growth Testing (RD/GT) also are supposed to be defined in contractor's internal RMAD Program Command Media. (b) The SSPP identifies the system's quality improvement requirements. (c) The RMAD Program Plan describes the general RD/GT implementation tasks. (d) The Product Reliability Growth Plan describes the detailed RD/GT implementation tasks. (e) The FRACAS and the FRB play crucial roles in identifying and mitigating reliability design defects. Those roles should be defined in the FRACAS Plan and FRB Charter.
Program Coordination	1	The RMAD Program Lead ensures that the appropriate RMAD disciplines participate in all program meetings/reviews in which decisions are made that impact the product's reliability or maintainability design. NOTE: These reviews/meetings include Engineering Change Board (ECB) meetings, Failure Review Board (FRB) meetings and Configuration Control Board (CCB) meetings.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) MIL-STD-1543B (Tailored) (c) MIL-STD-785B (Tailored) (d) MIL-STD-470B (Tailored) (e) Customer's Statement of Work (SOW) (f) Contractor's proposal and subcontractor RFP/SOW (g) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group	(a) AIAA Standard S-102.0.1 and the contractor's internal RMAD Program Command Media provide general requirements for RMAD disciplines to participate in all program meetings/reviews in which decisions are made that impact the product's reliability or maintainability design. (b) MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), and the SOW should provide specific requirements for RMAD disciplines to participate in all program meetings/reviews in which decisions are made

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
			(RMWG) charter (b) Plans and Charters of Individual Systems Engineering Functions	that impact the product's reliability or maintainability design. (c) All of the RMAD requirements and their sources are supposed to be identified in the Requirements vs. Tasks Matrix in the RMAD Program Plan. (d) The RMAD Program Plan should include a Requirement versus Responsible Discipline Matrix that identifies all of the RMAD requirements that other disciplines in Systems Engineering have. (e) The Plan or Charter of each systems engineering function is supposed to include a Requirements vs. Tasks Matrix. (f) The appropriate RMAD disciplines participate in the FRB review and disposition of functional test discrepancies that involve mission critical functions.
	1	The RMAD Program Lead plans, assigns, monitors, reports status of, reviews, approves, and distributes the engineering/analytical reports and customer deliverables that RMAD disciplines are responsible for performing.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) MIL-STD-1543B (Tailored) (c) MIL-STD-785B (Tailored) (d) MIL-STD-470B (Tailored) (e) Customer's Statement of Work (SOW) (f) Contractor's proposal and subcontractor RFP/SOW (g) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter. (b) Integrated Master Schedule (IMS)	(a) AIAA Standard S-102.0.1 and the contractor's internal RMAD Program Command Media provide general requirements for the RMAD Program Lead's responsibilities, including but not limited to, planning, assigning, monitoring, reporting status of, reviewing, approving, and distributing the engineering/analytical reports and customer deliverables that RMAD disciplines are responsible for performing. (b) MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), and the SOW should provide specific requirements for the RMAD Program Lead's responsibilities. (c) All of the engineering/analytical reports and customer deliverables that RMAD disciplines are responsible for performing are supposed to be identified in the RMAD Program Plan and IMS.
	2	The RMAD Program Lead ensures that RMAD disciplines coordinate with systems engineering disciplines to plan and implement the development and exchange of RMAD data products (i.e., giver and receiver) involving shared program tasks (e.g., trade studies) and shared customer submittals.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) MIL-STD-1543B (Tailored) (c) MIL-STD-785B (Tailored) (d) MIL-STD-470B (Tailored) (e) Customer's Statement of Work (SOW) (f) Contractor's proposal and subcontractor RFP/SOW (g) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Integrated Master Schedule (IMS)	(a) AIAA Standard S-102.0.1 provides general requirements for RMAD disciplines to coordinate with systems engineering disciplines to plan and implement the development and exchange of RMAD data products (i.e., giver and receiver) involving shared program tasks (e.g., trade studies) and shared customer submittals. (b) MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), and the SOW should provide specific requirements for RMAD disciplines to coordinate with systems engineering disciplines to plan and implement the development and exchange of RMAD data products (i.e., giver and receiver) involving shared program tasks and shared customer submittals. (c) The RMAD Program Plan should identify the systems engineering disciplines that share

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
				responsibility with RMAD disciplines for planning and developing RMAD data products and customer submittals. (d) All RMAD data products and customer submittals that are jointly generated are supposed to be included in the IMS.
	2	The RMAD Program Lead ensures RMAD inputs to key project documents are properly coordinated, reviewed, and approved.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Key Project Documents • Product Specifications • Calibration Standards • Production Procedures • Inspection Procedures	(a) AIAA Standard S-102.0.1 provides general requirements for coordinating, reviewing, and approving RMAD inputs to key documents. (b) Contractor's Internal RMAD Program Command Media should provide guidance for coordinating, reviewing, and approving RMAD inputs to key documents. (c) All key project documents that require RMAD inputs should be identified in the RMAD Program Plan. (d) Each key project document for which RMAD provides a significant input is supposed to have an approval page with a signature line for the RMAD Program Lead.
	2	The RMAD Program Lead monitors the reliability and maintainability (R&M) activities of subcontractors during product design, manufacture, assembly, test, inspection, shipping, and operations.	**INPUTS:** (a) AIAA Standard S-102.1.2 (b) MIL-STD-1543B (Tailored) (c) MIL-STD-785B (Tailored) (d) MIL-STD-470B (Tailored) (e) Contractor's proposal and subcontractor RFP/SOW (f) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) R&M Working Group (RMWG) Meeting Minutes	(a) The subcontractor's generic RMAD requirements and deliverables are identified in the AIAA Standard S-102.1.2. (b) All of the subcontractor's RMAD requirements and deliverables are identified in the MIL-STD-1543B (Tailored), MIL-STD-785B (Tailored), MIL-STD-470B (Tailored), and the SOW. (c) The RMAD Program Lead periodically convenes R&M Working Group (RMWG) meetings to ensure that subcontractors are properly implementing their required RMAD tasks.
	3	All reliability and maintainability (R&M) stake-holders are identified and provided with applicable R&M design checklists to aid their R&M design activities.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.2.6 (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Reliability and Maintainability (R&M) Design Checklists	(a) AIAA Standard S-102.0.1 provides general requirements for identifying stake-holders and providing them with applicable R&M design checklists to aid their R&M design activities. (b) AIAA Standard S-102.2.6 provides general R&M design rules. (c) Contractor's Internal RMAD Program Command Media should provide applicable R&M design rules. (d) The RMAD Program Plan should identify all Systems Engineering disciplines that have R&M design responsibilities. (e) The RMAD Program Plan should identify the development and distribution of R&M design checklists as tasks. (f) The RMAD Program Lead coordinates the documentation, approval, and distribution of R&M design checklists.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
	3	The contractor establishes and maintains a project-wide RMAD Database.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.2.6 (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) SEMP (c) IMP (d) Project RMAD Database Specification	(a) AIAA Standard S-102.0.1 provides general requirements for the contractor to establish and maintain a project-wide RMAD Database. (b) AIAA Standard S-102.2.6 provides general content requirements for a project-wide RMAD Database. (c) Contractor's Internal RMAD Program Command Media should provide specific content requirements for a project-wide RMAD Database. (d) The RMAD Program Plan, SEMP, and IMP should define the purpose and structure of the project-wide RMAD Database. (e) The Project RMAD Database Specification should identify the data sources and data fields for the project-wide RMAD Database.
	3	The RMAD Program collects, reviews, and utilizes R&M lessons learned, as applicable, and ensures that other disciplines also collect and utilize R&M lessons learned to help identify existing and potential design weaknesses early. NOTE: These lessons learned include design, test, and operating guidelines. NOTE: This objective includes evaluating customer reported failures and subcontractor Failure/Discrepancy Reports.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) Contractor's Internal RMAD Program Command Media (c) Failure Analysis Reports (d) FRB Meeting Minutes **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) SEMP (c) IMP (d) Lessons Learned Report (e) Lessons Learned Review Committee (LLRC) Meeting Minutes	(a) AIAA Standard S-102.0.1 provides general requirements for projects to collect, review, and utilize R&M lessons learned. (b) Contractor's Internal RMAD Program Command Media should provide applicable RMAD lessons learned that were obtained from failure analysis reports or FRB meeting minutes. (c) The RMAD Program Plan, SEMP, and IMP describe the program-wide Lessons Learned process. (d) The Lessons Learned Report describes the new Lessons Learned records that were approved since the last publication. (e) Quality assurance is the administrator of the program-wide Lessons Learned process, which includes moderating the Lessons Learned Review Committee (LLRC) meetings and documenting meeting minutes.
	3	The RMAD Program Lead chairs R&M Working Group (RMWG) meetings with peers on a regular basis to review RMAD reports/data, mitigate or control identified failure mode risks, and resolve problems.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.3 (c) Contractor's Internal RMAD Program Command Media (d) Project Risk Management Plan **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) R&M Working Group (RMWG) meeting minutes.	(a) AIAA Standard S-102.0.1 provides general requirements for the RMAD Program Lead to chair R&M Working Group (RMWG) meetings with peers on a regular basis. (b) AIAA Standard S-102.1.3 provides general requirements for the objectives, approach, and structure of a RMWG. (c) Contractor's Internal RMAD Program Command Media should provide specific requirements for the objectives, approach, and structure of a RMWG. (d) The RMAD Program Lead monitors all RMAD activities program-wide and convenes RMWG meetings on an as needed basis to review RMAD reports/data and disposition high and serious hazard risks, in accordance with the project's Risk Management Plan. (e) All of the action items that come out of an

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
				RMWG meeting are supposed to be documented and tracked until closure.
	4 & 5	The RMAD Program Lead ensures all RMAD stake-holders are trained to properly utilize the R&M design checklists that they are provided with.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) RMAD Training Materials	(a) AIAA Standard S-102.0.1 provides general requirements for the RMAD Program Lead to ensure all RMAD stake-holders are trained to properly utilize the R&M design checklists that they are provided with. (b) Contractor's Internal RMAD Program Command Media should provide guidance on the types of RMAD training that would be useful for specific systems engineering disciplines. (c) The RMAD Program Plan should describe any planned RMAD training for identified systems engineering disciplines in the project. (d) The RMAD Program Lead should review and approve the RMAD training materials.
Engineering & Evaluation	1	The RMAD Program Lead ensures that the systems engineering disciplines generate detailed functional diagram models (FDMs) in design specifications to ensure they accurately represent the required reliability design functions. NOTE: This includes software logic flow diagram models in software component specifications.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.2.1 (c) Contractor's Internal RMAD Program Command Media (d) Hardware and Software Design Specifications **OUTPUTS:** (a) Failure Mode, Effects, and Criticality Analysis (FMECA) Report	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.1 provide general requirements for developing detailed functional diagram models (FDMs). (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for developing detailed FDMs. (c) The RMAD disciplines provide comments to the creators of FDMs via the Comment Resolution Matrix (CRM) on an as needed basis. (d) The Reliability Program Lead ensures that detailed FDMs are included in all FMECA reports, and each FDM has been reviewed and approved prior to distribution.
	1	A collaborative Product Failure Mode, Effects, and Criticality Analysis (FMECA) is developed which identifies all safety critical and mission critical hardware, software, and procedures. NOTE: This includes historical mishaps that were caused by operating software faults.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.2.4 (c) Contractor's Internal RMAD Program Command Media (d) Field Failure Reports (e) Test Discrepancy Reports (f) Lessons Learned (g) FMECA Reports (h) Reliability Prediction Reports (i) Hazard Reports (j) Safety Assessment Reports (SARs) **OUTPUTS:** (a) Product Failure Mode, Effects, and Criticality Analysis (FMECA) Report	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.4 provide general requirements for a collaborative Product Failure Mode, Effects, and Criticality Analysis (FMECA). (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for developing a collaborative Product FMECA. (c) The Product FMECA is performed in accordance with the product's unit-value/criticality and development life cycle.
	1	A collaborative Critical Items List (CIL) is developed which identifies all critical items, along with their appropriate controls.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.6 (c) Contractor's Internal RMAD Program	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.1.6 provide general requirements for a collaborative Critical Items List (CIL).

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
			Command Media (d) Field Failure Reports (e) Test Discrepancy Reports (f) Lessons Learned (g) FMECA Reports (h) Reliability Prediction Reports (i) Hazard Reports (j) Safety Assessment Reports (SARs) **OUTPUTS:** (a) Critical Items List (CIL)	(b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for developing a collaborative CIL. (c) The CIL process is performed in accordance with the product's unit-value/criticality and development life cycle.
	1	Reliability engineering performs component reliability predictions.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.3 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Component Reliability Predictions	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.3 provide general requirements for component reliability predictions. (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing component reliability predictions. (c) The component reliability predictions process is performed in accordance with the product's unit-value/criticality and development life cycle.
	2	Reliability engineering performs system reliability modeling.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.2 (d) AIAA Standard S-102.2.3 (e) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) System Reliability Modeling	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, AIAA Standard S-102.2.2, and AIAA Standard S-102.2.3 provide general requirements for system reliability modeling. (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing system reliability modeling. (c) The system reliability modeling process is performed in accordance with the product's unit-value/criticality and development life cycle.
	2	The RMAD Program Lead ensures that all RMAD disciplines coordinate with other systems engineering disciplines to perform Design Concern Analysis in a timely manner.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.5 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Design Concern Analysis (DCA)	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.5 provide general requirements for Design Concern Analysis (DCA). (b) The contractor's internal RMAD Program Command Media is supposed to include or reference design rules, and provide guidelines for performing DCA. (c) The DCA process is performed in accordance with the product's unit-value/criticality and development life cycle.
	2	The RMAD Program Lead ensures that all RMAD disciplines coordinate with other systems engineering disciplines to perform Worst Case Analysis in a timely manner.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.8 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Worst Case Analysis (WCA) Report	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.8 provide general requirements for Worst Case Analysis (WCA). (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing WCA. (c) The WCA process is performed in accordance with the product's unit-value/criticality and

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
				development life cycle.
	2	Survivability Engineering performs Environmental Event / Survivability Analysis in a timely manner.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.10 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Environmental Event / Survivability Analysis Report	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.8 provide general requirements for Environmental Event / Survivability Analysis. (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing Environmental Event / Survivability Analysis. (c) The Environmental Event / Survivability Analysis process is performed in accordance with the product's unit-value/criticality and development life cycle.
	2	Reliability engineering performs software component reliability predictions.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.15 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Software Component Reliability Predictions	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.15 provide general requirements for software component reliability predictions. (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing software component reliability predictions. (c) The software component reliability predictions process is performed in accordance with the product's unit-value/criticality and development life cycle.
	2	Maintainability engineering performs maintainability predictions.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.12 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Maintainability Predictions	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.12 provide general requirements for maintainability predictions. (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing maintainability predictions. (c) The maintainability predictions process is performed in accordance with the product's unit-value/criticality and development life cycle.
	3	The Lead Reliability Engineer ensures that circuit design engineering, software design engineering, test engineering, and systems safety engineering participate in the iterative design and analysis of the Anomaly Detection and Response (ADR) functions to develop an ADR Design Specification.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.11 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) ADR Design Specification	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.11 provide general requirements for Anomaly Detection and Response (ADR) analysis. (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing ADR analysis. (c) The ADR analysis process is performed in accordance with the product's unit-value/criticality and development life cycle.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
	3	Reliability engineering performs Operational Dependability and Availability Modeling.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.13 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Operational Dependability and Availability Modeling	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.13 provide general requirements for Operational Dependability and Availability Modeling. (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing Operational Dependability and Availability Modeling. (c) The Operational Dependability and Availability Modeling process is performed in accordance with the product's unit-value/criticality and development life cycle.
	3	Reliability engineering performs Similarity and Allocations Analysis to allocate and predict reliability.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.20 (d) Statement of Work (SOW) (e) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Similarity and Allocations Analysis (b) Subsystem and Assembly Level Design Specifications	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.22 provide general requirements for Similarity and Allocations Analysis. (b) The product reliability requirements should be defined in the SOW and flowed down to the product design specifications using industry acknowledged reliability allocation methods. (c) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for using industry acknowledged Similarity and Allocations Analysis methods to flow down the system level reliability requirements to the subsystem and assembly level design specifications. (d) The Similarity and Allocations Analysis process is performed in accordance with the product's unit-value/criticality and development life cycle.
	3	Reliability engineering performs Stress and Damage Simulation Analysis to predict reliability.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.22 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Stress and Damage Simulation Analysis	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.22 provide general requirements for Stress and Damage Simulation Analysis. (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for using industry acknowledged Stress and Damage Simulation Analysis methods to predict reliability. (c) The Stress and Damage Simulation Analysis process is performed in accordance with the product's unit-value/criticality and development life cycle.
	3	The Lead Reliability Engineer ensures that circuit structural engineering and circuit thermal engineering collaboratively perform Finite Element Analysis (FEA) to identify circuit design weaknesses.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.7 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Finite Element Analysis (FEA)	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.7 provide general requirements for Finite Element Analysis (FEA). (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing FEA to identify circuit design weaknesses. (c) The FEA process is performed in accordance with

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
				the product's unit-value/criticality and development life cycle.
	4 & 5	The Lead Reliability Engineer ensures that design engineering and reliability engineering collaboratively perform Sneak Circuit Analysis (SCA).	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.5 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Sneak Circuit Analysis (SCA)	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.5 provide general requirements for Sneak Circuit Analysis (SCA). (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing SCA. (c) The SCA process is performed in accordance with the product's unit-value/criticality and development life cycle.
	4 & 5	The Lead Reliability Engineer ensures that human factors engineering, manufacturing engineering, quality engineering, and reliability engineering collaboratively perform Process Failure Mode, Effects, and Criticality Analysis (Process FMECA).	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) AIAA Standard S-102.2.16 (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Process Failure Mode, Effects, and Criticality Analysis (Process FMECA)	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.1, and AIAA Standard S-102.2.5 provide general requirements for performing a collaborative Process Failure Mode, Effects, and Criticality Analysis (Process FMECA). (b) The contractor's internal RMAD Program Command Media is supposed to provide guidelines for performing a collaborative Process FMECA. (c) The Process FMECA is performed in accordance with the product's unit-value/criticality and development life cycle.
	4 & 5	The Lead Reliability Engineer ensures that key input data and assumptions that are used in all RMAD engineering and analytical tasks are identified and evaluated with regard to their maturity. NOTE: An example is the assumed software reliability growth rate at time of delivery.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) Contractor's Internal RMAD Program Command Media (d) Individual Systems Engineering Discipline Plans **OUTPUTS:** (a) Systems Engineering Discipline Analytical Reports that include results obtained from RMAD engineering and analytical tasks.	(a) AIAA Standard S-102.0.1 and AIAA Standard S-102.1.1 provide general requirements for evaluating the key input data and assumptions used in RMAD engineering and analytical tasks. (b) The contractor's RMAD Program Command Media should require all systems engineering disciplines to evaluate the maturity of the input data and assumptions that are used in all RMAD engineering and analytical tasks for very high unit-value/criticality products. (c) The analytical reports of the various systems engineering disciplines should identify the maturity of the input data and assumptions used for each RMAD engineering and analytical task. (d) The analytical reports of the various systems engineering disciplines should also identify any uncertainties associated with the input data used for each RMAD engineering and analytical task.
	4 & 5	The Lead Reliability Engineer ensures that validated computer-aided mission assurance tools are acquired and integrated to the greatest extent practical to form a comprehensive RMAD toolset.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) Contractor's Internal RMAD Program Command Media (d) Individual Systems Engineering Discipline Plans **OUTPUTS:** (a) Systems Engineering Discipline Analytical	(a) AIAA Standard S-102.0.1 and AIAA Standard S-102.1.1 provide general requirements for an integrated computer-aided RMAD toolset. (b) Contractor's RMAD Program Command Media should require that validated computer-aided mission assurance tools be acquired and integrated to the greatest extent practical to form a comprehensive RMAD toolset for very high

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
			Reports	unit-value/criticality products. (c) The analytical reports of the various systems engineering disciplines should identify the validated computer-aided RMAD tools that were used.
The mitigation/control approaches that are chosen for the identified failure mode risks are all tracked to closure.	1	The failure mode risk mitigation/control order of precedence is implemented in accordance with the MIL-STD-882C order of precedence and enforced across the systems engineering process.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) MIL-STD-882C (c) AFI 91-202 AFSPC SUP1 (d) AFI 91-217 (e) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Risk Management Plan (RMP) (c) Failure Review Board (FRB) Charter (d) Configuration Control Board (CCB) Charter	(a) AIAA Standard S-102.0.1 provides general requirements for failure mode risk mitigation/control order of precedence that is consistent with MIL-STD-882C. (b) The contractor's internal RMAD Program Command Media should call for projects to use a failure mode risk mitigation order of precedence that is compliant with MIL-STD-882C, AFI 91-202 AFSPC SUP1, and AFI 91-217. (c) The contractor's RMAD Program Plan, Risk Management Plan (RMP), FRB charter, and CCB charter should all define a risk mitigation order of precedence that is compliant with MIL-STD-882C.
	1		**INPUTS:** (a) AIAA Standard S-102.0.1 (b) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Risk Management Plan (RMP) (c) Failure Review Board (FRB) Charter (d) Configuration Control Board (CCB) Charter (e) Risk Management Database Report (f) Hazard Tracking Log Database	(a) AIAA Standard S-102.0.1 provides general requirements for tracking to closure the chosen mitigation/control approaches for the identified failure mode risks. (b) The contractor's internal RMAD Program Command Media should provide guidelines for tracking to closure the mitigation/control approaches that are chosen for the identified failure mode risks. (c) The contractor's RMAD Program Plan, Risk Management Plan, Failure Review Board (FRB) Charter, and other Plans and Charters, should all define the process for tracking to closure the chosen mitigation/control approaches for the identified failure mode risks. (d) The contractor's Risk Management Database Report and the Hazard Tracking Log Database should identify the failure mode risk mitigations/controls that are being tracked.
	1	All high and serious failure mode risks are reported to the proper risk acceptance authority and appropriately adjudicated.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.6 (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) Individual Systems Engineering Discipline Plans (b) RMAD Program Plan and R&M Working Group (RMWG) charter (c) Risk Management Plan (RMP) (d) Failure Review Board (FRB) Charter (e) Configuration Control Board (CCB) Charter (f) Risk Management Database Report (g) Hazard Tacking Log Database	(a) AIAA Standard S-102.0.1 and AIAA Standard S-102.1.6 provide general requirements for reporting failure mode risks to the proper risk acceptance authority. (b) The contractor's internal RMAD Program Command Media should provide guidelines for identifying and reporting high and serious failure mode risks. (c) The contractor's RMAD Program Plan, Risk Management Plan, Failure Review Board (FRB) Charter, and other Plans and Charters, should all define the risk metrics for high and serious failure mode risks. (d) The high and serious failure mode risks should be

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
				identified in the Risk Management Database Report and the Hazard Tracking Log Database.
	2	The order of precedence for ranking opposing failure mode risks is: (1) safety-critical, (2) mission-critical, (3) reliability-critical, (4) maintenance-critical, and (5) monitoring-critical. NOTE: This order of precedence is consistently applied across the project.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.6 (c) AIAA Standard S-102.2.4 (d) AIAA Standard S-102.2.5 (e) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) RMAD Program Plan (SSPP) (c) Risk Management Plan (RMP)	(a) AIAA Standard S-102.0.1, AIAA Standard S-102.1.6, AIAA Standard S-102.2.4, and AIAA Standard S-102.2.5 provide general requirements for ranking opposing failure mode risks. (b) The contractor's internal RMAD Program Command Media should provide guidelines for ranking opposing failure mode risks (c) The contractor's RMAD Program Plan, System Safety Program Plan (SSPP), and Risk Management Plan should all define a consistent order of precedence for ranking opposing failure mode risks.
	3	The RMAD Program Lead holds Reliability and Maintainability (R&M) Working Group meetings with peers on a regular basis to review identified failure mode risks and choose or evaluate the risk mitigation/control methods.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.3 (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) RMWG Meeting Minutes	(a) AIAA Standard S-102.0.1 and AIAA Standard S-102.1.3 provide general requirements for the Reliability and Maintainability Working Group (RMWG) to review and disposition mission-critical failure mode risks. (b) The contractor's internal RMAD Program Command Media should call for the RMAD Program Lead to hold RMWG meetings with peers on a regular basis to review and disposition failure mode. (c) The RMAD Program Plan should describe the periodic RMWG meetings as level of effort (LOE) tasks. (d) The RMWG meeting minutes should identify the new action items and the status of all the old action items that have not been closed.
	3	The RMAD Program Lead ensures that all requests for a reliability design requirement waiver involving a mission-critical function include evidence that the level of residual failure mode risk is acceptable.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) System Safety Program Plan (c) Risk Management Plan (d) Waiver Request (e) Waiver Request Risk Assessment Report	(a) AIAA Standard S-102.0.1 provides general requirements for processing reliability design waiver requests. (b) The contractor's internal RMAD Program Command Media should provide guidelines for processing a request for a reliability design requirement waiver that involves a mission-critical function. (c) The RMAD Program Plan, System Safety Program Plan (SSPP), and Risk Management Plan should require the requester to provide evidence that the level of residual failure mode risk is acceptable. (d) The RMAD disciplines should evaluate the waiver request, and if necessary, generates a Risk Assessment Report: NOTE: The Waiver Request Risk Assessment Report should quantify the residual risk associated with the risk item.
	4 & 5	The RMAD Program Lead periodically inspects/audits various systems engineering disciplines (including system safety) to identify and	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) MIL-STD-882C	(a) AIAA Standard S-102.0.1 provides general requirements with regard to periodic inspection of various systems engineering disciplines.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
		mitigate/control latent hardware, software, and process failure mode risks early.	(c) Customer's Statement of Work (SOW) (d) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) RMAD Program Inspection/Audit Report	(b) The contractor's internal RMAD Program Command Media should require a periodic audit of various systems engineering disciplines. (c) The contractor's internal RMAD Program Command Media should include the RMAD inspection/audit criteria. (d) The SOW should include requirements for the customer to periodically inspect/audit the contractor, and/or for the contractor to periodically inspect/audit the major subcontractors. (e) The RMAD Program Plan should include a level of effort (LOE) task for periodically auditing the internal project disciplines and the key sub contractors. (f) The results of the inspection/audit should be documented in the RMAD Program Inspection/Audit Report.
	4 & 5	Overlooked, missing, or deficient RMAD tasks are identified, assessed for residual risk, and those found to be unacceptable are reported to the appropriate risk acceptance authority for adjudication.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.1 (c) Contractor's Internal RMAD Program Command Media (d) MIL-STD-785B (Tailored) (e) MIL-STD-1543B (Tailored) (f) MIL-STD-470B (Tailored) (g) Statement of Work (SOW) **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Risk Management Plan (RMP) (c) Requirements Hazard Analysis Report	(a) AIAA Standard S-102.0.1 and AIAA Standard S-102.1.1 provide general requirements for planning an RMAD Program that is commensurate with the product's unit value/criticality and life cycle phase. (b) The contractor's internal RMAD Program Command Media should provide guidance for planning an RMAD Program that is commensurate with the product's unit value/criticality and life cycle phase. (c) MIL-STD-785B (Tailored), MIL-STD-1543B (Tailored), and MIL-STD-470B (Tailored),and the SOW should identify all of the required RMAD Program tasks. (d) The contractor's RMAD Program Plan and Risk Management Plan (RMP) should include tasks to identify overlooked, missing, or deficient RMAD tasks. (e) The Requirements Hazard Analysis Report should be performed to identify overlooked, missing, or deficient RMAD tasks.
	4 & 5	The 5x5 risk matrix metrics defined in AFI 63-101 should be applied in all risk assessments as part of a single program-wide risk management process. NOTE: A risk matrix that is based on the hazard risk metrics defined in MIL-STD-882C, the criticality metrics defined in MIL-STD-1629A, or another source, must be translated to the 5x5 risk matrix metrics defined in AFI 63-101.	**INPUTS:** (a) AIAA Standard S-102.0.1 (b) AIAA Standard S-102.1.6 (c) AFI 63-101 (d) MIL-STD-882C (e) MIL-STD-1629A (f) Statement of Work (SOW) (g) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Risk Management Plan (RMP)	(a) AIAA Standard S-102.0.1 and AIAA Standard S-102.1.6 provide general requirements for applying the 5x5 risk matrix metrics defined in AFI 63-101. (b) A risk matrix that is based on the hazard risk metrics defined in MIL-STD-882C, the criticality metrics defined in MIL-STD-1629A, or another source, must be translated to the 5x5 risk matrix metrics defined in AFI 63-101. (c) The program-wide risk matrix format should be defined in the SOW. (d) The contractor's RMAD Program Command Media should provide guidance for assessing risk

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
				in accordance with the 5x5 risk matrix metrics defined in AFI 63-101. (e) The contractor's RMAD Program Plan and Risk Management Plan should all define the translation format for going from a 4x4 system safety risk matrix to a 5x5 risk matrix.
Requirements Verification (Including Ongoing Reliability Testing)	1	System level performance tests are used to verify the design reliability of the delivered product qualitatively.	**INPUTS:** (a) Test Plans (b) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter	(a) The Test Plans define the product's performance requirements. (b) The contractor's RMAD Program Command Media should provide guidance for using performance test results to verify the design reliability of the delivered product qualitatively. (c) The contractor's RMAD Program Plan should describe the product's performance tests.
	2	Handbook Reliability Prediction methods and Similarity Analysis are used to verify the design reliability requirements for mission-critical hardware and software functions.	**INPUTS:** (a) AIAA Standard S-102.2.2 (b) AIAA Standard S-102.2.3 (c) AIAA Standard S-102.2.15 (d) AIAA Standard S-102.2.20 (e) Statement of Work (SOW) (f) Product Design Specifications (g) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Handbook Reliability Predictions	(a) AIAA Standard S-102.2.2, AIAA Standard S-102.2.3, AIAA Standard S-102.2.15, and AIAA Standard S-102.20 provide general requirements for applying Handbook Reliability Prediction methods and Similarity Analysis methods to verify design reliability requirements. (b) The contractor's RMAD Program Command Media should provide guidance for using industry acknowledged Handbook Reliability Prediction methods and Similarity Analysis methods to verify design reliability requirements. (c) The contractor's RMAD Program Plan should describe the Handbook Reliability Prediction and Similarity Analysis tasks.
	3	Stress and Damage Simulation Reliability Prediction methods are used to verify the design reliability requirements for mission-critical hardware and software functions.	**INPUTS:** (a) AIAA Standard S-102.2.2 (b) AIAA Standard S-102.2.3 (c) AIAA Standard S-102.2.15 (d) Statement of Work (SOW) (e) Product Design Specifications (f) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Stress and Damage Simulation Reliability Predictions	(a) AIAA Standard S-102.2.2, AIAA Standard S-102.2.3, and AIAA Standard S-102.2.15 provide general requirements for applying Stress and Damage Simulation Reliability Prediction methods to verify design reliability requirements. (b) The contractor's RMAD Program Command Media should provide guidance for performing industry acknowledged Stress and Damage Simulation Reliability Prediction methods to verify the design reliability requirements. (c) The contractor's RMAD Program Plan should describe the Stress and Damage Simulation Reliability Prediction tasks.
	3	Reliability Life Testing is used to verify the operational reliability of life-limited safety-critical or mission-critical components.	**INPUTS:** (a) AIAA Standard S-102.3.4 (b) Test Plans (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Reliability Life Testing	(a) AIAA Standard S-102.3.4 provides the general requirements for Reliability Life Testing. (b) The Test Plans should define the specific requirements for Reliability Life Testing. (c) The contractor's RMAD Program Command Media should provide guidance for Reliability Life Testing. (d) The contractor's RMAD Program Plan should describe the Reliability Life Testing tasks.

PROGRAM AREA	CAPABILITY LEVEL	OBJECTIVES	CANDIDATE ARTIFACTS	OUTPUT ARTIFACT EVALUATION CRITERIA
	4 & 5	Reliability, Maintainability, and Availability Demonstration Testing is used to verify the initial reliability of the delivered product.	**INPUTS:** (a) AIAA Standard S-102.3.3 (b) Test Plans (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Reliability, Maintainability, and Availability Demonstration Testing	(a) AIAA Standard S-102.3.3 provides the general requirements for Reliability, Maintainability, and Availability Demonstration Testing. (b) The Test Plans should define the specific requirements for Reliability, Maintainability, and Availability Demonstration Testing. (c) The contractor's RMAD Program Command Media should provide guidance for Reliability, Maintainability, and Availability Demonstration Testing. (d) The contractor's RMAD Program Plan should describe the Reliability, Maintainability, and Availability Demonstration Testing tasks.
	4 & 5	Reliability Development/Growth Testing is used to verify the reliability growth rate of the delivered or sustained products.	**INPUTS:** (a) AIAA Standard S-102.3.2 (b) Test Plans (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Reliability Development/Growth Testing	(a) AIAA Standard S-102.3.3 provides the general requirements for Reliability Development/Growth Testing. (b) The Test Plans should define the specific requirements for Reliability Development/Growth Testing. (c) The contractor's RMAD Program Command Media should provide guidance for Reliability Development/Growth Testing. (d) The contractor's RMAD Program Plan should describe the Reliability Development/Growth Testing tasks.
	4 & 5	Ongoing Reliability Testing is used to verify the operational reliability of the delivered product.	**INPUTS:** (a) AIAA Standard S-102.3.6 (b) Test Plans (c) Contractor's Internal RMAD Program Command Media **OUTPUTS:** (a) RMAD Program Plan and R&M Working Group (RMWG) charter (b) Ongoing Reliability Testing	(a) AIAA Standard S-102.3.3 provides the general requirements for Ongoing Reliability Testing. (b) The Test Plans should define the specific requirements for Ongoing Reliability Testing. (c) The contractor's RMAD Program Command Media should provide guidance for Ongoing Reliability Testing. (d) The contractor's RMAD Program Plan should describe the Ongoing Reliability Testing tasks.

5.6.3 Apply Lessons Learned

If a Capability Level 3 or higher RMAD process is required, the contractor will describe how existing RMAD data/reports will be reviewed for applicable product-based[4] and process-based[5] lessons learned. Existing lessons learned will be reviewed to identify possible deficiencies or needed process improvements, such as, improved procedures or training materials.

Candidate lessons learned will be evaluated for quality, prioritized, and forwarded to the Lessons Learned Approval Authority for appropriate action. SET will take steps to ensure that candidate lessons learned are documented and reviewed in a timely manner, and the related recommendations infused throughout the project, the stakeholder organizations, and as necessary, enterprise-wide using the appropriate systems. The Project RMAD Database System will include a field that permits an authorized person to indicate that particular data is a lessons learned candidate. A positive indication in the lessons learned field will generate a notification to a Lessons Learned Review Committee or similar approval authority regarding the data's candidacy.

If a Capability Level 4 or higher RMAD process is required, SET will describe how mission assurance lessons learned will be exchanged with other projects throughout the enterprise, e.g., the project will transmit approved RMAD lessons learned to other projects for information and comments.

If a Capability Level 5 RMAD process is required, SET will describe how non-proprietary lessons learned data will be exchanged with other organizations, e.g., the enterprise will enter into data exchange agreements and employ safeguards to protect security-classified, International Traffic in Arms Regulations (ITAR)-restricted, proprietary, or other sensitive data. The received data will be reviewed by an enterprise-level Lessons Learned Board to identify significant findings that should be implemented on a project or enterprise-wide.

5.7 Verify RMAD Requirements Are Met

SET will verify that the RMAD requirements are met. If a Capability Level 1 RMAD process is required, SET will use informal methods to track the flowed down requirements to verify that RMAD requirements are satisfied. The informal verification methods will involve review and concurrence by internal management only. If a Capability Level 2 or higher RMAD process is required, SET will use formal methods to track the flowed down requirements to verify that RMAD requirements are satisfied. The formal verification methods will involve review and concurrence by the acquisition authority.

[4] For this standard, a product-based lesson learned is important information created, documented, and retrieved according to a system or device life cycle specific functional or physical descriptor.

[5] For this standard, process-based lesson learned is important information created, documented, and retrieved according to a process or procedure descriptor.