Reliability and Maintainability Objectives Hierarchy
R&M Objectives Hierarchy – Top Level

Top Objective: System performs as required over the lifecycle to satisfy mission objectives

Strategy: Prevent faults and failures, provide mitigation capabilities as needed to maintain an acceptable level of functionality considering safety, performance, and sustainability objectives

Objective: System conforms to design intent and performs as planned (1)

Objective: System remains functional for intended lifetime, environment, operating conditions and usage (2)

Objective: System is tolerant to faults, failures and other anomalous internal and external events (3)

Objective: System is designed to have an acceptable level of availability and maintenance demands (4)

Context: Expectations derived from crew safety, MMOD concerns, facility safety, public safety, mission obj., sustainment, ..., considerations and associated risk tolerance

Context: System/function description and requirements, including design information and interfaces

Context: Reference mission + before/after

Context: Range of nominal / off-nominal usage and conditions/ environments
Objective: System conforms to design intent and performs as planned (1)

Context: All other non-R&M centered verification and validation activities

Strategy: Verify and validate nominal functionality (1.A)

Objective: Nominal functionality at each level of the system has been verified and validated, including hardware and software design compatibility (1.A.1)

Strategy: Demonstrate to an acceptable level that the functionality of the system meets the design intent (1.A.1.A)

Strategy: Identify causes of anomalies (1.B.1.B)

Strategy: Test, inspect, and demonstrate to an acceptable level that issues are found (1.B.1.A)

Objective: Faults, defects, or other latent issues have been found as part of the testing/inspection process (1.B.1)

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Strategy: Test and inspect adequately to identify and resolve faults, issues and defects (1.B)

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Objective: All issues are resolved or closed out to an acceptable level of risk (1.B.2)

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Objective: All issues are resolved or closed out to an acceptable level of risk (1.B.2)

Strategy: Track, address, and trend issues via a closed loop problem resolution process (1.B.2.A)

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Strategy: Achieve high level of process reliability (1.C)

Objective: Built system and its components do not contain flaws/faults that reduce ability to withstand loads and stresses (1.C.1)

Strategy: Select appropriate quality components and materials (1.C.1.A)

Strategy: Perform process reliability reviews to ensure consistency of reliability design processes with interdependent engineering analyses (1.C.1.B)

Strategy: Establish and verify manufacturing processes and handling criteria (1.C.1.C)

Strategy: Screening, proof testing and acceptance testing (1.C.1.D)
Objective: System remains functional for intended lifetime, environment, operating conditions and usage (2)

Context: Description of operating environment, including static, cyclical, and randomly varying loads

Strategy: Understand failure mechanisms, eliminate and/or control failure causes, degradation and common cause failures, and limit failure propagation to reduce likelihood of failure to an acceptable level (2.A)

Objective: System and its elements are designed to withstand nominal and extreme loads and stresses (radiation, temperature, pressure, mechanical, …) for the life of the mission (2.A.1)

Strategy: Apply design standards to incorporate margin to account for variable and unknown stresses (2.A.1.A)

Strategy: Evaluate and control nominal stresses and related failure causes (2.A.1.B)

Strategy: Evaluate and control potential for extreme stresses and related failure causes (2.A.1.C)

Strategy: Perform qualification testing and life demonstration to verify design for intended use (2.A.1.D)

Strategy: Evaluate and control coupling factors and shared causes between redundant (or dependent) components (2.A.2.A)

Objective: System or its elements are not susceptible to common-cause failures (2.A.2)

Strategy: Evaluate and control coupling factors and shared causes between redundant (or dependent) components (2.A.2.A)

Objective: System and its components meet quantitative reliability criteria (2.B.1)

Strategy: Determine reliability allocation (2.B.1.A)

Strategy: Estimate reliability based on applicable performance data, historical data of similar systems, and/or physics-based modeling (2.B.1.B)

Strategy: Support design trades based on reliability analysis (2.B.1.C)

Strategy: Plan and perform life testing (2.B.1.D)

Strategy: Track and monitor reliability performance over time (2.B.1.E)
Objective: System is tolerant to faults, failures and other anomalous internal and external events (3)

Strategy: Assure that system includes necessary barriers and mitigations to keep anomalous events from compromising the ability to meet mission objectives (3.A)

Objective: System has multiple means of accomplishing functions that are critical to mission objectives including safety (3.A.1)

Strategy: Provide similar or dissimilar functional redundancy (3.A.1.A)

Objective: Physical and functional pathways for fault propagation or combination are limited (3.A.2)

Strategy: Separate redundant paths functionally and physically (3.A.2.A)

Strategy: Isolate and contain faults (3.A.2.B)

Strategy: Evaluate and control shortest path to worst case effects (e.g. hazardous events) (3.A.2.C)

Objective: System is able to recover from anomalies affecting functions that are important to top-level expectations. (3.A.3)

Strategy: Provide fault management (detection, active isolation, recovery) capabilities (3.A.3.A)

Objective: System is able to recover from anomalies affecting functions that are important to top-level expectations. (3.A.3)

Strategy: Provide fault management (detection, active isolation, recovery) capabilities (3.A.3.A)

Objective: System can degrade or lose functions without significantly impacting top-level expectations (through contingency operations) (3.A.4)

Strategy: Plan contingency or other off nominal operations (3.A.4.A)

Context: Hardware and Software interactions and interfaces
Objective: System has an acceptable level of maintainability and operational availability (4)

Strategy: Evaluate, control, and monitor the ease of maintaining, restoring, or changing system capability and total maintenance demands (4.A)

Objective: Maintenance and repair activity can be performed within available resources (cost, time) (4.A.1)

Strategy: Design to facilitate on-orbit and ground maintenance and check out (4.A.1.A)

Strategy: Design to minimize maintenance complexity for reduction of maintenance time and training requirements (4.A.1.B)

Strategy: During design, consider tool selection, transport, stowage, ease of use, and criticality as well as complexity of robotic maintenance capability where feasible (4.A.1.C)

Strategy: Use standardization to limit the number of feasible design options and encourage the use of common items, procedures, processes, tools, etc (4.A.1.D)

Strategy: Perform RCM (on orbit/ground support systems) during design to optimize the design for maintainability (4.A.1.E)

Strategy: Perform maintainability simulation and analysis as needed to support design and logistic support analysis (4.A.1.F)

Strategy: Provide demonstration testing to verify ‘detect, diagnose, isolate’ capability of systems and confirm corrective and preventive maintenance task actions and analysis (4.A.1.G)


Objective: System provides clear indication of health status, degradations, and diagnostic information (4.A.2)

Strategy: Identify and optimize the testability and diagnostics characteristics to support the maintainability requirements (4.A.2.A)

Strategy: Incorporate fault detection/isolation/recovery at the lowest practical level to support the maintainability requirements (4.A.2.B)

Strategy: Develop test-point-design strategies to minimize access time and system intrusion (4.A.2.C)


Objective: System design allows for reconfiguration, upgrade, or growth opportunities during the mission (4.A.3)

Strategy: Design the system to accommodate future technology or changes in application over the design life via maintenance activities (4.A.3.A)

Strategy: Design for physical and functional interchangeability with other like components and assemblies in the system (4.A.3.B)

Strategy: Incorporate modular designs to facilitate remove-and-replace maintenance and allow flexibility in the design (4.A.3.C)

Strategy: Establish capabilities and processes to collect and store operational history, health status, degradation, diagnostic, and maintenance data (4.A.4.A)


Strategy: Ensure availability of data to future programs and projects (4.A.4.D)

Objective: Maintainability performance is validated and optimized during operations based on available maintenance data (4.A.4)

Strategy: Ensure availability of data to future programs and projects (4.A.4.D)