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**ARMY CAPABILITIES INTEGRATION CENTER**  
**CAPABILITIES ASSESSMENT & RAM DIVISION**  
**RELIABILITY, AVAILABILITY & MAINTAINABILITY (RAM)**  
**ENGINEERING BRANCH**

**FAILURE DEFINITION AND SCORING CRITERIA (FDSC)**  
*for the*  
**BRIDGE ERECTION BOAT (BEB)**

**Revision 4**



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PREPARED FOR:

**UNITED STATES ARMY MANEUVER SUPPORT CENTER OF EXCELLENCE**  
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*“Excellence in Engineering, Scientific, Technical, & Analytical Services  
for the Combat Developments Community”*

**FAILURE DEFINITION AND SCORING CRITERIA (FDSC)  
for the  
BRIDGE ERECTION BOAT (BEB)  
Revision 4**

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**CERTIFICATION SHEET**

**Purpose:** This Failure Definition and Scoring Criteria (FDSC) supports the evaluation of the BEB Reliability, Availability and Maintainability (RAM). It will be used to determine classification and chargeability of test incidents, which occur during RAM related testing (such testing should be conducted in accordance with an approved Operational Mode Summary/Mission Profile (OMS/MP)). Further, it will be used for establishing an agreed upon data base which will be used to project operational RAM values for estimates of operational suitability and ownership costs, and to determine contractual compliance. Revision 4 was necessary to incorporate scoring changes which were agreed to at downselect scoring conferences.

**System Description:** The bridge erection boat is specified to be a twin-engine, shallow draft, waterjet propelled boat intended specifically to support bridging operations and be compatible with Multi-Role Bridge Company (MRBC) equipment, such as the M1977 Common Bridge Transporter (CBT) truck, the M1076 Palletized Load System Trailer (PLST), M16/M17 Improved Ribbon Bridge (IRB). If needed, the BEB could use the M14 Improved Boat Cradle (IBC) or the M15 Bridge Adaptor Pallet (BAP). The BEB's draft is minimized to match its companion floating bridge bays. The primary purpose of the BEB is to construct floating bridges and rafts from IRB bays and Line of Communications Bridge (LOCB) floats. It can push bridge bays for ferry raft operations, and can temporarily anchor bridges until more permanent anchorage is available. The BEB also serves as a safety boat during bridging and rafting operations, and for engineer water reconnaissance missions. This procurement of the BEB will replace the aging BEB fleet with newer, more capable boats which can support the enhanced performance of the IRB.

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Date: 24 Sep 2012

**BRIDGE ERECTION BOAT (BEB)  
FAILURE DEFINITION AND SCORING CRITERIA (FDSC)  
Revision 4**

**1. GENERAL.** The FDSC will be used to determine classification and chargeability of test incidents that occur during Developmental Test (DT) and Operational Test (OT) testing. Testing will be based on the IRB Operational Mode Summary/Mission Profile (OMS/MP). This FDSC will be used for establishing an agreed upon data base, which will be used to project operational RAM values for estimates of operational suitability and ownership costs, and to determine contractual compliance. Further, it is written under U.S. Army Training and Doctrine Command (TRADOC) format and guidelines. Revision 4 was necessary to incorporate scoring changes which were agreed to at downselect scoring conferences.

**2. SYSTEM DESCRIPTION.** The bridge erection boat is specified to be a twin-engine, shallow draft, waterjet propelled boat intended specifically to support bridging operations and be compatible with Multi-Role Bridge Company (MRBC) equipment, such as the M1977 Common Bridge Transporter (CBT) truck, the M1076 Palletized Load System Trailer (PLST), M16/M17 Improved Ribbon Bridge (IRB). If needed, the BEB could use the M14 Improved Boat Cradle (IBC) or the M15 Bridge Adaptor Pallet (BAP). The BEB's draft is minimized to match its companion floating bridge bays. The primary purpose of the BEB is to construct floating bridges and rafts from IRB bays and Line of Communications Bridge (LOCB) floats. It can push bridge bays for ferry raft operations, and can temporarily anchor bridges until more permanent anchorage is available. The BEB also serves as a safety boat during bridging and rafting operations, and for engineer water reconnaissance missions. This procurement of the BEB will replace the aging BEB fleet with newer, more capable boats which can support the enhanced performance of the IRB.

**3. FAILURE DEFINITION.**

a. Essential Functions. The BEB must provide the following essential functions in all scenarios/mission profiles depicted in the IRB OMS/MP.

(1) Controlled Movement.

(a) Propel and Hold. The BEB must be capable of providing and directing the necessary thrust to propel, position, or hold in-place floating bays, rafts, bridge sections, and bridges which are subject to external forces (currents, etc).

(b) Maneuver. The BEB must be capable of being safely started and operated, must provide controlled forward, rearward, and sideways movement of the boat relative to the movement of the body of water in which it is being operated, and must be able to provide the controlled movements/maneuvers necessary to fulfill its role in the construction and maintenance of floating bridges and rafts.

(c) Buoyancy. The BEB must be capable of maintaining buoyancy and of expelling water which is taken on from small leaks, waves, weather, and other normal operating conditions in order to maintain seaworthiness and stability to support bridging operations.

(2) Interface. The BEB must maintain proper interfaces for connecting to, disconnecting from, and propelling floating bays.

(3) Launch and Retrieve. The BEB must be capable of being launched and retrieved in an expedient manner by MRBC equipment by no more than two Soldiers.

b. Failure Definition. The following definitions of failure and clarifications are applicable to the BEB:

(1) Essential Function Failure (EFF) and System Abort (SA)

(a) An *Essential Function Failure (EFF)* is defined as the inability to perform or significant degradation in one or more of the essential functions. Table 1 provides examples and clarifications to aid in identification and scoring of EFFs (as well as other possible failure classifications).

(b) An EFF that prevents the system from beginning or continuing operations (see Table 1) is also scored as a *System Abort (SA)*. A System Abort may result in a “Not Mission Capable” status or reduce system utility to the point that it is deemed ineffective/unsafe in its designated role. Note, each System Abort is also by definition an EFF and thus is properly annotated as “EFF/SA”. Failures resulting in Critical or Catastrophic safety hazards are also considered as EFF/SA. Normally, the repair of an EFF cannot be deferred for any significant length of time and must be fixed at the first opportunity (i.e., end of mission day).

(2) A Non-Essential Function Failure (Non-EFF) is defined as loss of non-essential functions, degradation of essential functions not meeting the criteria of an EFF, or minor malfunctions related to either essential or non-essential functions. This also includes those items, which are covered under the crew correctible conditions described in the EFF definition. Normally, the repair of a Non-EFF can be deferred until the system is undergoing other maintenance.

(3) A Rapidly Recoverable Event (RRE) is defined as an incident which is otherwise considered an EFF or an EFF/SA but which can be quickly corrected by the crew using only normally available tools, spares, or repair parts (see below). This exemption is subject to a limit of two such events per boat per day (16 hours of operation); subsequent events will be scored on their own merit. Acceptable time limits for the crew actions are 5 minutes during launching and boat operations in the water, 15 minutes prior to launch, and 15 minutes during and following retrieval. Acceptable crew actions qualifying for this exemption must be either authorized crew/operator level maintenance actions or the crew/operator performance/ repetition of defined operating procedures (i.e. restarting engine). “Normally available tools, spares, and repair parts” are defined to include transporter, boat, or bay Basic Issue Items (BII), and other items which are readily available to the unit (i.e. “leatherman” type tool, engineer tape, etc). Failures such as engine shutdowns which occur during rafting or bridging operations when the boat is being utilized to propel and direct floating bridge components represent a significant safety concern and are not subject to be classified as an RRE.

(4) A Dependent Failure is a secondary event which is caused (induced) by the failure of

another item (i.e. secondary item wouldn't have failed on its own at that time) and which occurs simultaneous or nearly simultaneous with the causing event. Normally all related information is reported and scored on a single TIR; this category is used when related failures are reported on separate TIRs and it is appropriate to treat the incidents as a single failure. In some cases, it may be necessary to present engineering evidence to clearly link the dependent event to the causing event. The related incidents are scored as if one incident had occurred. The first (primary) incident is scored normally (EFF, EFF/SA, etc). The secondary incident(s) are scored as Dependent Failures and charged to the failure of the primary incident (using Primary Incident Chargeability). Thus, the system is charged a single failure event but all related maintenance time is counted.

(5) Clarifications.

(a) Failures that are discovered during scheduled maintenance or corrective maintenance for an unrelated failure are normally considered on their own merit, regardless of when they are discovered. Sometimes a failure is discovered which did not exhibit noticeable symptoms or which did not affect operations enough for an investigation to be initiated, but by their nature are serious events (i.e. Class III oil leak). If the operator or maintainer can correct an EFF incident discovered during other maintenance (or PMCS) without requiring a higher level of maintenance, and without requiring any part which would not be normally available, the incident will be considered a Non-EFF only. If more than one EFF or EFF/SA failure is discovered at one time, the scoring body should use their judgment as to the scoring of these incidents, taking into account the cumulative maintenance time for all newly discovered EFF failures. All incidents not meeting these guidelines will be scored under their own merits. An EFF or EFF/SA will be scored regardless in cases where a failure is detected on a subsystem during scheduled/corrective maintenance that would have been considered an EFF or EFF/SA during the performance of the mission if an attempt had been made to operate the affected subsystem.

(b) Damage occurring to the boats due to being launched under less than required water depths is considered a known performance limitation and is scored as "Other Events – Performance Limitation".

(c) Debris in the waterjets which can be cleared by the crew in 10 minutes or less and without requiring removal of the boat from the water is scored as Non-Failure – Routine Operating Procedure. No limit is set on the frequency of these events, as they will be driven by the condition of the water in which the boat will be operating.

(d) In general, Built-In-Test (BIT) / Self-Test false alarms which indicate loss of one or more essential functions are scored as though an actual failure has occurred, unless overwhelming evidence or circumstances exists to the contrary (i.e. fuel indicator shows empty, but crew checks and verifies adequate fuel levels).

(e) Scoring of leaks. For most systems, the operator's manual indicates that the existence of any Class III leak is cause for the equipment to be deadlined. Army Regulation 385-10, The Army Safety Program, section 11-4, paragraph j(1) states that "Army motor vehicles will not be operated unless they are entirely free of gasoline, JP 8, or Class III diesel leaks.." In practical experience, and as verified by Engineer School

Subject Matter Experts, a distinction is often made for Class III leaks in a wartime scenario taking into account the degree of the leak (i.e. 1 drop per minute versus a steady stream), the type of system leaking (i.e. fuel vs. hydraulic fluid), and the ability to monitor the amount of fluid remaining.

1) A Class III leak is defined as a leak where one or more drops have formed and dripped or spilled. Class II leaks are defined as leaks where fluid is accumulating and drops may be forming but have not yet dripped or spilled. A Class I leak is defined as wetness around the area of the leak.

2) Hydraulic leaks will be scored with respect to their effect on safely beginning or continuing the mission, based upon what is known of the location and extent of the leak and the size of the hydraulic reservoir and any redundancy in the hydraulic system that would allow continued operation. Class III leaks do not automatically cause an Essential Function Failure. Low-rate class III leaks that can be accessed and corrected by tightening are generally scored as Non-EFF. However, a steady stream or spray of hydraulic fluid, or other evidence of a substantial leak will often be cause for scoring an EFF. The overall effect of the leak should be judged based on the capacity of the fluid reservoir, the rate of leakage, and the overall effect of the leak on the function of the hydraulic system. A high rate of leakage combined with a low fluid capacity is an usual cause for scoring an EFF. The opposite, a low leakage rate from a high capacity system, will not usually be a cause for scoring an EFF. Measurement, if possible, should be used to assess the ability of the equipment to complete the mission successfully. Often the extent or location of an internal hydraulic leak cannot be readily judged, and the incident may be scored an EFF or EFF/SA due to the deadlining of the equipment to assess the nature of the leak, rather than the actual leak characteristics.

**TABLE 1. Essential Function Failure Expansion Matrix for BEB**

<b>ESSENTIAL FUNCTION</b>	Failure Criteria, Expansion, and Examples
<b>CONTROLLED MOVEMENT</b>	
System Abort (EFF/SA)	<p>Greater than 50% degradation in overall system power, maneuverability, and/or control due to a malfunction. Examples include:</p> <ul style="list-style-type: none"> <li>• Failure of engines, waterjets, or other power train components which results in loss of or significantly reduced propulsion from both jets (or total loss of propulsion from one jet and reduced propulsion from the other jet)</li> <li>• Cannot start engines (neither can be started)</li> </ul> <p>Significant degradation in thrust or control due to a single engine/waterjet malfunction during operations in which the boat is performing bridge building or rafting operations.</p> <p>Rapid intake of water due to cracks or seal damage which exceeds bilge pump capacity and which results in significant degradation (as defined above) in ability to perform mission or which causes (or will rapidly cause) sinking/capsizing. This condition may also arise from failure of one or more bilge pumps combined with a lesser water intake resulting in a significant water accumulation.</p> <p>Control/monitoring failure:</p> <ul style="list-style-type: none"> <li>• Loss of ability to effectively steer BEB, involving loss of helm control (via steering wheel/linkages) combined with failure of propulsion from or forward/reverse control of one or more waterjets (steering can be effectively accomplished with forward/reverse control of jets in cases where operator is unable to steer via steering wheel).</li> </ul> <p>Leaks (internal system fluids) in non-redundant systems, or leaks in redundant systems which cannot be isolated to allow one of the redundant systems to remain operational, and which exceed the following leak rates (“internal fluid” leak criteria does not apply to the raw water cooling system. Leaks of that system are scored solely on their effect on accomplishment of the essential functions) :</p> <ul style="list-style-type: none"> <li>• Leak rate &gt; 1 drop/second</li> <li>• Class III Fuel leak greater than one drop per minute, or resulting in hazard from fuel accumulation within the BEB</li> </ul>
Essential Function Failure (EFF)	<p>Noticeable but minor degradation (greater than 30%) in overall system mobility or speed due to a malfunction (not occurring while boat is performing bridge building or rafting operations):</p> <ul style="list-style-type: none"> <li>• Engine, waterjet or other component failure resulting in loss or significantly reduced propulsion from one waterjet, where other waterjet system is fully operable, such as failure of fuel pump, clogged fuel filter, turbocharger failure or restriction, failure of engine electronics or fuel control resulting in no fuel flow, or waterjet failure</li> <li>• Loss of engine oil pressure in one engine causing shutdown, or engine oil drops below prescribed minimum for extended period (other engine fully operable)</li> <li>• Cooling system failure resulting in engine overheating (other engine fully operable)</li> </ul> <p>Degraded control/monitoring capability</p> <ul style="list-style-type: none"> <li>• Degraded steering range or maneuverability</li> <li>• Failure of fuel gauge which results in running out of fuel during mission</li> <li>• Unable to monitor oil pressure or engine temperature</li> </ul> <p>Failure of all external lighting</p> <p>Leaks (internal system fluids) which exceed the following leak rates:</p> <ul style="list-style-type: none"> <li>• Any Class III fuel leak</li> <li>• Degradation of steering due to loss of ability to utilize primary steering mechanism to control the watercraft, as long as steering can be accomplished via forward/reverse control of waterjets</li> </ul>

<b>ESSENTIAL FUNCTION</b>	Failure Criteria, Expansion, and Examples
Non-Essential Function Failure (Non -EFF)	<p>Radio failure (if equipped)</p> <p>Global Positioning System (GPS) or Depth Finder failure</p> <p>Failure of personnel heater</p> <p>Failure of gauges or instrumentation (other than oil pressure or temperature gauge)</p> <p>Tripped CB(s) impacting function that can be reset on the first attempt</p> <p>Class I/II fuel leak (wetness, no falling drops)</p> <p>Loose bolts, connectors, etc. which can be deferred indefinitely</p> <p>Fluid leak (non-fuel) &lt;= 1 drop/minute (including Class I/II leaks)</p>
<b>INTERFACE</b>	
System Abort (EFF/SA)	<p>Failures which result in the loss of the ability to safely connect to, release from, and secure the boat to floating bays</p> <ul style="list-style-type: none"> <li>• One or more push-knee failures which prevent proper interface with the floating bays, or which would result in significant damage to the bay or boat if utilized in its failed configuration</li> <li>• Visible permanent deformation, yielding, or bending of a tie off</li> </ul>
Essential Function Failure (EFF)	<p>Failures which degrade the ability to safely connect to and secure the boat to floating bays;</p> <ul style="list-style-type: none"> <li>• Failure which degrades ability to secure the boat to floating bays, or to quickly disconnect from bays</li> <li>•</li> </ul>
Non-Essential Function Failure (Non-EFF)	<p>Minor failures which do not degrade the ability to connect to and secure the boat to floating bays:</p> <ul style="list-style-type: none"> <li>• Rips and tears in rub-rail</li> </ul>
<b>LAUNCH AND RETRIEVE</b>	
System Abort (EFF/SA)	<p>Failures of the BEB which prevent the boat from being launched or retrieved</p> <p>Failure of the BAP/IBC which is caused by the BEB and which prevents the boat from being launched or retrieved</p>
Essential Function Failure (EFF)	<p>Failures of the BEB which significantly degrade the ability of the boat to be launched or retrieved</p> <p>Failure of the BAP/IBC which is caused by the BEB and which significantly degrades the ability of the boat from being launched or retrieved</p>
Non-Essential Function Failure (Non-EFF)	<p>Other failures of the BEB related to launch and retrieve capability which do not significantly impact the ability to launch or retrieve</p>



**4. SCORING CRITERIA.** Classification of an event is based upon its impact on system operational performance. Primary classification categories are: Reliability Failure Event, Non-Reliability Failure Event, and Other Event or Failure. Failure events are divided into Essential Function Failure (EFF), System Abort (SA), Non-Essential Function Failure (Non-EFF), Rapidly Recoverable Event (RRE), or Dependent Failure. Once an event has been classified as a failure, chargeability is assigned. Actual maintenance need not be performed in order to assign chargeability. Figure 1 depicts the general scoring process.

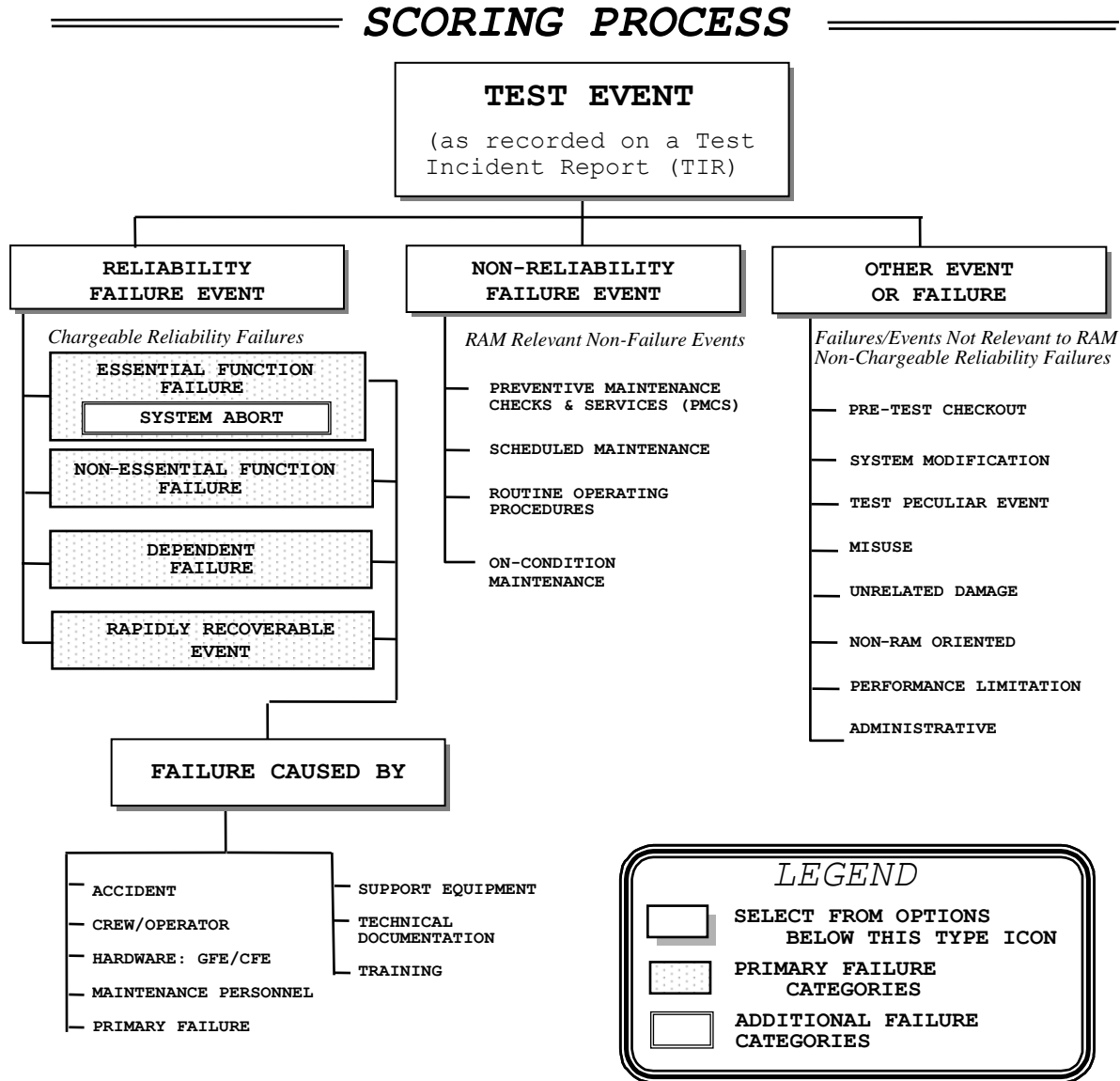


Figure 1 -- Generalized Scoring Process

**Scoring Procedure**

- a. Select appropriate category below and proceed as directed:
  - (1) Event is "Non-Reliability Failure" (Non-failure events relevant to RAM). Proceed to action b.
  - (2) Event is " Other Event or Failure" (Failures/Events not relevant to RAM, or Non-chargeable reliability failures). Proceed to action c.
  - (3) Event is "Reliability Failure". Proceed to action d.
- b. Assign event to appropriate category, then proceed to next event/incident:
  - (1) Preventive maintenance, checks, or services (PMCS).
  - (2) Scheduled maintenance.
  - (3) Routine operating procedures performed by operator and prescribed in user manual.
  - (4) On-Condition Maintenance
- c. Identify the event as one of the following and proceed to next event/incident:
  - (1) Pre-test checkout.
  - (2) System (hardware or software) modification.
  - (3) Test peculiar.
  - (4) Misuse.
  - (5) Non-RAM oriented.
  - (6) Unrelated damage.
  - (7) Performance Limitation.
  - (8) Administrative.
- d. Assign event to one of the following failure categories and proceed to action e:
  - (1) EFF.
  - (2) EFF/SA.
  - (3) Non-EFF.
  - (4) RRE.
  - (5) Dependent Failure.
- e. Identify the cause of the event from the following list:
  - (1) Accident.
  - (2) Crew/Operator.
  - (3) Hardware.
    - (a) Government Furnished Equipment.
    - (b) Contractor Furnished Equipment.
  - (4) Maintenance personnel.
  - (5) Primary Failure (for incidents classified as "Dependent Failures" only).
  - (6) Support Equipment.
  - (7) Technical Documentation.
  - (8) Training.

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**5. INSTRUCTIONS FOR TEST DATA COLLECTION.** Accurate collection of certain data and information is critical to successful evaluation of a systems RAM performance. Some of this information and data is used by scoring personnel to make final determinations regarding categorization of reliability failures. Maintenance and supply demand categories, defined in a later section, are determined based on the failure category assigned or by definition. Following is a list of data and information that should be collected:

- o Maintenance level
- o MOS performing maintenance
- o Maintenance clock-minutes/hours used
- o Maintenance man-minutes/hours used
- o Spare parts, LRUs, or SRUs used
- o Repair parts used
- o POL quantity used
- o Crew Correctable Maintenance Demand (CCMD)
- o Scheduled Maintenance Demand (SMD)
- o Non-Essential Unscheduled Maintenance Demand (NUMD)
- o Essential Unscheduled Maintenance Demand (EUMD)
- o Essential Logistics Demand (ELD)
- o Non-Essential Logistics Demand (NELD)
- o Durability Failures

**6. DEFINITIONS.**

a. Chargeability Definitions.

(1) Accident: events caused by accidents not due to the design of the system or inadequate training or careless operation. Damage caused by natural phenomena (lightning, earthquakes, etc), submerged tree limbs, submerged pilings, "icebergs", and other influences that are beyond the control of the operational elements of the system are considered as "Other Events – Non RAM Oriented". Systemic failure modes occurring during normal operating conditions which are induced by natural phenomena (such as damage to keel cooler due to impact on rocks, shore, submerged limbs) should not be charged as "Accident", but should be charged against the hardware/design.

(2) Crew/Operator: events attributable to crew/operator error that were not rooted in hardware/software design, inadequate training, or poorly written manuals.

(3) Hardware: malfunctioning hardware and personnel related events caused by poor hardware design. This category may be subdivided into sub-categories (i.e. government furnished and contractor furnished).

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(4) Maintenance Personnel: events attributable to maintenance personnel errors that were not rooted in hardware/software design problems, inadequate training, or poorly written manuals.

(5) Primary Failure: secondary malfunctions which are directly attributable to an initial malfunction. For instance, if a surge protector fails and causes a microprocessor to burn up, the microprocessor failure is charged to "Primary Failure" due to the failed surge protector.

(6) Support Equipment: events attributable to special tools, common tools, TMDE, spares, repair parts, associated software or other special equipment not part of the operational system.

(7) Technical Documentation: events attributable to misleading, incorrect, or nonexistent but needed technical information.

(8) Training: events that can be directly attributed to inadequacies in training due to omitted or incorrect training procedures, or inappropriate training material.

b. Crew Correctable Maintenance Demand (CCMD). A CCMD is generated when a maintenance action is performed by the crew/operator and such action is authorized at the crew/operator level in the TM or applicable documentation. A CCMD is generated only by applicable EUMDs or NUMDs.

c. Dependent Failure. A secondary failure event which is caused (induced) by the failure of another item (i.e. secondary item wouldn't have failed on its own at that time) and which occurs simultaneous or nearly simultaneous with the causing event. The related incidents are scored as if one incident had occurred. This category is used when related events are written up on separate TIRs. The first (primary) incident is scored normally (EFF, EFF/SA, etc), while considering all effects of both the primary and dependent failures. The secondary incident(s) are scored as Dependent Failures and charged to the failure of the primary incident (using Primary Incident Chargeability). Thus, the system is charged a single failure event but all related maintenance time is counted. An example would be a hydraulic or fuel hose failure leading to a fire in the engine compartment. Normally, these items would be described on a single Test Incident Report, but if two TIRs were written, the first would be scored an EFF/SA and the second would be scored a Dependent Failure and charged to "Primary Failure". Maintenance times from both incidents would be considered chargeable. Normally, the primary and dependent events are covered by the same TIR, but it may be possible for the exact cause of the secondary event to not be known at the time of the failure and result in two TIRs being written.

d. Essential Function Failure (EFF). Any event which causes the inability to perform an essential function or which causes significant degradation in performance below specified levels in one or more of the essential functions, as defined in paragraph 3. Normally, the repair of an EFF cannot be deferred for any significant length of time and must be fixed at the first opportunity (i.e., end of mission day).

e. Essential Logistics Demand (ELD). An ELD is scored for all essential unscheduled maintenance demands and all scheduled maintenance demands that require parts or line

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replaceable units (LRUs). An ELD is recorded for each part requested or consumed. Thus, it is possible to record more than one ELD per event. This category does not include operator or crew level PMCS.

f. Essential Unscheduled Maintenance Demand (EUMD). A EUMD is recorded for each event requiring unscheduled maintenance that cannot be deferred until the next scheduled maintenance point at the prescribed level of maintenance. This means that by definition, all EFFs resulting in maintenance actions generate EUMDs. Non-EFFs may also result in EUMDs. Crew safety and potential damage to the system are other key considerations in determining what maintenance is non-deferrable. Repair of fully redundant components, or restoration of a degraded essential function will also result in a EUMD. Note that a EUMD that is corrected and authorized by the crew/operator also generates a CCMD.

g. Non-EFF. Failure events, which cannot be classified as an essential function failure. A Non-EFF may result in loss of non-essential functions, degradation of essential functions not meeting the criteria for an EFF, or minor malfunctions related to either essential or non-essential functions. A Non-EFF will normally generate a Non-Essential Unscheduled Maintenance Demand (NUMD). If maintenance were performed, a non-EFF resulting from degradation in one or more essential functions would generate an Essential UMD (EUMD). It is not always the case that a failure generates an unscheduled maintenance demand. Normally, the repair of a Non-EFF can be deferred until the system is undergoing other maintenance.

h. Non-Essential Logistics Demand (NELD). An NELD is recorded for all non-essential unscheduled maintenance demands that require parts or line replaceable units (LRUs). An NELD is recorded for each part requested or consumed. Thus, it is possible to record more than one NELD per event. This category does not include operator or crew level PMCS.

i. Non-essential Unscheduled Maintenance Demand (NUMD). An NUMD is any unscheduled maintenance action and which can be deferred until the next scheduled maintenance period at the prescribed level of maintenance. This category is used to cover the remaining incidents that require unscheduled maintenance but did not qualify as EUMDs. A NUMD performed by the crew also generates a CCMD.

j. Other Event or Failure. These are events which are not relevant to RAM, or which are non-chargeable RAM events as described below. Events scored thusly will not have a chargeability assigned and will not be included in the overall reliability and maintainability evaluations of the system, although corrective actions may nevertheless be required. These events may reflect systemic performance problems or malfunctions discovered during non-RAM testing (i.e. environmental, vibration, shock testing) that affects reliability but is not used directly in the evaluation of RAM. These events may include pre-test checkout/inspections, equipment modifications, test-peculiar events, test-directed abuse (e.g. test directed stresses beyond the performance limit of the system), unrelated damage, and other non-RAM related events. Further expansion of some this category follows:

- (1) Pre-test checkout. Events observed during burn-in, pre-test inspection, or other pre-test activities.

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(2) Equipment modification. All maintenance actions involved in the installation of hardware kits or incorporation of redesigned components. If the replaced component was not functioning at the time of its replacement with the modification, the event will be scored on its own merit. The maintenance time will be estimated based on the time to restore the system to its original condition. Subsequent events related to the malfunction will be scored on their own merit.

(3) Test peculiar. Events caused by equipment that is not part of the system being tested or people not acting as test players (crew or maintenance personnel). Engineering evaluations to analyze the cause of the malfunctions, as well as any malfunctions and/or maintenance efforts caused by the engineering evaluation. Events related to test peculiar diagnostic equipment used in lieu of the diagnostic equipment, which will be fielded, are scored on their own merits.

(4) Misuse. Events in which official test participants (crewmembers or maintenance personnel) cause damage to the system either willfully or through gross negligence are subject to being classified as abuse (ultimately, a decision for the Scoring Conference members to make after considering the facts). This category also includes any incidents in which the tester directs the deliberate misuse of the system (e.g. a test excursion to exceed the performance limits of the system), whether called for by the test plan or not. Events attributable to misuse will not be scored against the system, as they provide no viable indication of its ability or inability to function reliably in the operational environment.

(5) Unrelated Damage. This category includes damage caused by natural phenomena (e.g. lightning, earthquakes, etc.) and other influences that are beyond the control of the operational elements of the system. Accidents caused by hardware malfunction or other operational elements of the system (crew, maintainers, etc.) are charged on their own merit.

(6) Non-RAM Oriented. Events for which a test incident report might be initiated by the test activity, but which are not events used in RAM computations. Examples include suggested improvements, reports on inadequate test procedure, unusable or unacceptable replacement parts which were discovered prior to or during installation test schedule delays, and suggested human factors improvements. Recommended changes to the system support package not related to a specific event are also covered here.

(7) Performance Limitation. This includes those test incidents which report the inability of the system to meet a specified performance criterion even though no malfunction/failure has occurred.

(8) Administrative. Incidents noting administrative details of testing, such as the start or end of the test, addition or removal of test articles, or notes relating to performance testing.

k. Non-Failure Event. An event in which no actual failure has occurred. A non-failure event may consist of, but is not limited, to any of the following events:

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(1) Preventive Maintenance Checks and Services (PMCS). This includes those procedures defined as PMCS in the system's technical documentation. It does not include those incidents where a part is required (requirement of a replacement part infers that a component has failed or worn out which qualifies as a "failure" and requires corrective maintenance).

(2) Scheduled Maintenance. This includes those procedures defined as scheduled maintenance in the system's technical documentation.

(3) Routine Operating Procedures. Routine operating procedures performed by operator and prescribed in user manual. Routine tasks the operator or crew may quickly perform are not charged as failures. (Note: These do not include maintainer tasks that may be addressed in some user manuals.) This is not a catch-all category that accounts for ANY crew/operator correction. The intent is to not penalize a system for the performance of a normal, routine operating procedure in the operator's manual. These procedures should be based on how quickly and easily the crew or operator can do the task without impact on mission accomplishment, crew safety, etc. If frequency of occurrence is an issue, the manuals should address unacceptable recurrence. If the constraint is exceeded, the events will be recorded on their own merits as failures with associated maintenance demands. Debris in the waterjets which can be cleared by the crew using prescribed operating procedures (i.e., backflush) without requiring removal of the boat from the water is one example of this category. Another example would be infrequent incidents involving repetition of normal starting procedures where an engine fails to start on the first attempt.

(4) On-Condition Maintenance. Incident in which maintenance is performed to replace a used or worn part/component that has met its life expectancy criteria (i.e., its durability or service life requirement) constitutes "on-condition" maintenance if the part was still functional (functioning) at the time of its replacement. Examples of "on-condition" maintenance include replacement of fuel filters.

l. Rapidly Recoverable Event (RRE). A Rapidly Recoverable Event (RRE) is defined as an incident which is otherwise considered an EFF or an EFF/SA but which can be quickly corrected by the crew using only normally available tools, spares, or repair parts (see below). This exemption is subject to a limit of two such events per boat per day (16 hours of operation); subsequent events will be scored on their own merit. Acceptable time limits for the crew actions are 5 minutes during launching and boat operations in the water, 15 minutes prior to launch, and 15 minutes during and following retrieval. Acceptable crew actions qualifying for this exemption must be either authorized crew/operator level maintenance actions or the crew/operator performance/ repetition of defined operating procedures (i.e. restarting engine). "Normally available tools, spares, and repair parts" are defined to include transporter, boat, or bay Basic Issue Items (BII), and other items which are readily available to the unit (i.e. "leatherman" type tool, engineer tape, etc).

m. Scheduled Maintenance Demand (SMD). This is a maintenance action that is part of a program of preventive maintenance and is not attributable to an equipment failure. To qualify as an SMD, an event must meet the necessary intervals, usage requirements, conditions, and

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durability requirements defined in applicable system technical documentation (i.e. technical manuals).

n. System Abort (SA). An event resulting in loss or degradation of an essential function(s), which renders the system incapable of beginning or continuing operations. Every SA is also an EFF by definition.