

International Maintenance Review Board Policy Board (IMRBR)
Candidate Issue Paper (CIP)

Initial Date: 15-Feb-2013
IP Number: IP 129
Revision 0 / Date: 26-April-2013

Title: Lightning/HIRF (L/HIRF) Methodology Clarifications

Submitter: MPIG Sub-Committee on LHIRF Protection

Issue: After application of the L/HIRF MSG-3 methodology on several aircraft types, OEMs have identified several issues caused by current guidance:

1. Need to define scope (what must be analyzed), this needs to address use/definition of the word “Safety” in flow chart block 1
2. Definition of a L/HIRF Maintenance Significant Item (related to analysis scope)
3. MSG-3 analysis of components with good in-service performance (more guidance on how to use in-service data required)
4. Disassembly of L/HIRF protection components during scheduled maintenance (more guidance on task selection when disassembly is required)
5. Task Selection criteria (what tasks types can be selected)
6. Use of Engineering validation plans (what can MSG-3 take credit for; what is the relationship between task selection and validation plans)

Problem: Current L/HIRF MSG-3 methodology has been interpreted differently within the industry, creating inconsistent implementation.

Recommendation (including Implementation):

The MPIG LHIRF Sub-Committee has revised the L/HIRF logic diagram and supporting text and glossary as follows.

2-6. Lightning/High Intensity Radiated Field (L/HIRF) Analysis Procedure

This section contains guidelines for determining the dedicated scheduled maintenance tasks and intervals for L/HIRF protection using a progressive logic diagram. A glossary of terms and definitions used in the logic diagram is listed in Appendix A. This logic is the basis of an evaluation technique applied to each L/HIRF Significant Item (LHSI), using the data available and associated environments (ED/AD). Principally, the evaluations are based on the LHSI susceptibility to degradation. The LHIRF analysis is a collaborative effort between the OEM Design and Maintenance Engineering groups, which reviews the LHIRF protection items of critical systems and structure in order to maintain the inherent safety and reliability levels of the aircraft.

1. L/HIRF protection relies on both external and internal L/HIRF protection components.

1.1 Line Replaceable Unit (LRU) Internal L/HIRF Protection Components

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L/HIRF protection features are incorporated inside the LRU. Protection devices such as filter pin connectors, discrete filter capacitors and transient protection devices (tranzorbs) are installed within LRUs on one or more of the LRU interface circuits.

Application of MSG-3 logic for LRU internal protection features is not required. For LRUs whose failure could have an adverse effect on safety, the aircraft manufacturer will work with the LRU manufacturer to confirm that the LRU manufacturer's maintenance philosophy will ensure the continued effectiveness of L/HIRF protective features. This maintenance philosophy could include specific LRU CMM procedures or other data acceptable to regulatory authorities to conclude that the L/HIRF protection devices continue to perform their intended functions.

1.2 External On Aircraft L/HIRF Protection Components

L/HIRF protection (any protection not within an LRU) identified as or as part of an LHSI (Lightning/HIRF Significant Item) must be analyzed. Typical examples may include items such as shielded wires, raceways, bonding jumpers, connectors, composite fairings with conductive mesh, and the inherent conductivity of the structure, but may include aircraft specific devices, e.g., RF Gaskets.

2. Use of Lightning/HIRF Assurance Plan Philosophy

L/HIRF Assurance Plans, regardless of source, can be used to validate L/HIRF protection performance and/or maintenance program effectiveness.

After a task is proposed through the MSG-3 analysis process and where an L/HIRF Assurance Plan (or equivalent validation program) exists, the philosophy used in the L/HIRF MSG-3 logic is to either retain the proposed task or use the L/HIRF Assurance Plan (or equivalent validation program) to cover the intent of the MSG-3 task. For example, in cases where there is little data and the potential for degradation is low, an LHSI may be more effectively covered by the L/HIRF Assurance Plan.

3. Good Performance Philosophy

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OEMs may prepare a list of LHSIs that have demonstrated good performance that can be excluded from further MSG-3 analysis provided adequate justification data is collected, documented and presented to the WG for acceptance.

In order to show good performance, data demonstrating that the LHSI will remain effective in a similar environment will be provided (examples such as IP44 data, reliability data, in-service experience, validation, or testing results can be used).

2-6-1. L/HIRF Maintenance

Visual detection of obvious deterioration of L/HIRF protection is included in the Zonal Inspections; additional dedicated L/HIRF maintenance may not be required

1. L/HIRF Protection Analysis Concepts

The following concepts are accepted to support justification of no dedicated L/HIRF task:

1. Visible L/HIRF protection (e.g., wires, shields, connectors, bonding straps, or raceways between connectors or termination points) is addressed by the Zonal Inspections.
2. L/HIRF protection within conduit or heatshrink is addressed by the Zonal Inspections by confirming integrity of the protective covering.
3. Maintenance of the inherent conductivity of the metallic aircraft structure is addressed by the Zonal Inspections. Corrosion concerns are addressed by the Structural Inspections.
4. L/HIRF protection components with proven good in-service performance in a similar location and environment do not require detailed component assessment and no dedicated L/HIRF maintenance task is required.

2. LHSI Selection

Before the actual MSG-3 logic can be applied, the aircraft's significant L/HIRF protection must be identified. A detailed explanation of the LHSI selection process is provided in the logic diagram and L/HIRF protection analysis methodology.

3. L/HIRF Protection Analysis Methodology and Logic Diagram (see Figure 2-6-1.3)

Step 1: Identify L/HIRF Aircraft Protection by location

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OEM Engineering will provide a list of L/HIRF protection components for critical systems and structures, which are determined through a process acceptable to the certifying authority. This list will contain all systems and structural components required to maintain the inherent safety of the aircraft. Additional protection components can be added to the list at the discretion of the MSG-3 analyst. The aircraft protection components shall be identified by location on the aircraft.

Step 2: Establish list of LHSIs

The MSG-3 analyst will select candidate LHSIs (see definition in the Glossary) from the list provided in Step 1. The L/HIRF protection components will be grouped by area, component type, bonding path or any logical collection of similar components to form the boundaries of each LHSI as determined by the MSG-3 analyst. The candidate LHSI list will be submitted to the ISC for approval. As part of the MSG-3 analysis process, the Working Group will ensure the right level for the analysis has been chosen and may recommend changes to the ISC.

Step 3: Identify and list each LHSI protection component

For each LHSI, a list and description of the L/HIRF protection components will be provided for WG review. This will include a general description of the installation that may include material and finish. A process specification may be used to support the component installation description.

Step 4: Identify Environmental Deterioration / Accidental Damage (ED/AD) threats for each location

The ED/AD threats are determined in each location where LHSIs are installed. The ED/AD threats can be derived from a standalone process or the assessment from the Zonal analysis is acceptable.

Step 5: Perform a susceptibility assessment

For each LHSI, a process will be developed and utilized by the working group to determine a rating of the susceptibility of the protection components to degradation due to ED/AD.

Step 6: Is there data for listed or similar components with similar ED/AD threats that eliminates need for dedicated maintenance?

For all components listed in Step 3, a review of available data is accomplished. This data also must consider the component installation needs to be within a location with similar

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ED/AD threats. Criteria for determining favorable data will be developed by the OEM and utilized by the WG to determine if a dedicated L/HIRF task is necessary.

Step 7: No dedicated L/HIRF task

Self-explanatory.

NOTE: All visible components, including L/HIRF protection components, are inspected as part of the Zonal inspections.

NOTE: Justification of good performance shall be recorded for traceability.

Step 8: Assess component degradation modes and mitigations

An assessment process will be developed by the OEM and utilized by the working group to determine if there is a potential for unacceptable degradation of the protection components (including mitigation) due to ED/AD. Such mitigation within the installed environment may eliminate requirement for dedicated maintenance.

Step 9: Is there the potential for degradation?

If component is susceptible to unacceptable degradation within the installed location, proceed to Step 11.

Step 10: No dedicated L/HIRF Task

Self-explanatory.

NOTE: All visible components, including L/HIRF protection components, are inspected as part of the Zonal inspections.

Step 11: Is degradation detectable with a Zonal Inspection?

The L/HIRF WG will perform an assessment using access, visibility or other means to determine if degradation is detectable by a Zonal Inspection.

Step 12: Can an applicable an effective task accomplished without disassembly be selected? If so, select a task.

Determine if the potential degradation is detectable by a maintenance task without disassembly. If disassembly is required in order to detect identified potential degradation, then proceed to Block 13. If potential degradation is detectable without disassembly, then

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select appropriate level task that is most applicable and effective in detecting potential degradation from the following:

- 1) GVI
- 2) DET
- 3) FNC
- 4) SDI

NOTE: If there is an L/HIRF Assurance Plan (or equivalent validation program) in place, more credit can be given to detect protection degradation through applicable and effective visual inspections.

NOTE: At the WG discretion, a combination of tasks may be selected. In the case of multiple task selection, the Working Group should consider the cost of the task compared to the effectiveness of the combined tasks taking into consideration the cost of the protection degradation prevented. Consideration of interval to be selected in Step 15 can be used for the evaluation.

Step 13: Could disassembly significantly degrade the installation or impede ability to detect degradation? If not, select a task.

Accomplish an assessment of the effects of disassembly and compare the installation's probability for degradation, versus the effect of the disassembly. Also, consider if disassembly would negatively affect the ability to detect the protection degradation.

If this assessment shows a task is applicable and effective with disassembly, then select from the following and proceed to Step 15:

- a) GVI
- b) DET
- c) FNC
- d) SDI
- e) RST
- f) DIS

If assessment shows that the negative effects of disassembly outweigh the benefits of maintenance proceed to Step 14.

NOTE: If there is an L/HIRF Assurance Plan (or equivalent validation program) in place, more credit can be given to detect protection degradation through applicable and effective visual inspections.

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NOTE: At the WG discretion, a combination of tasks may be selected. In the case of multiple task selection, the Working Group should consider the cost of the task taking into consideration the effectiveness of the combined tasks compared to the cost of the protection degradation prevented. Consideration of interval to be selected in Step 15 can be used for the evaluation.

Step 14: Consider redesign or justify no task selected.

Consideration by the working group of the risks associated with disassembly results in redesign or no task selected. Use of disassembly to determine effectiveness of the LHIRF protection can result in unexpected additional deterioration or induce damage into the LHSI. An example may be removal of structural bonds that require special techniques or procedures that can cause damage or introduce human error. The possibility for a redesign is assessed by the OEM and results are provided to the Working Group. If redesign is not possible and disassembly is determined to be detrimental to the design, then an additional assessment should be made to justify no task being selected.

Step 15: For all tasks selected, identify the interval applicable for detecting potential degradation

To determine the maintenance task interval, the Working Group considers the impact of the ED/AD threat on the protection characteristics using best judgment and available information of expected degradation.

Step 16: Is there an L/HIRF Assurance Plan (or equivalent validation program)?

OEM to provide details to the Working Group may include summary of anticipated test methodologies, sample size details, and general information on type and number of test points.

Step 17: Does an L/HIRF Assurance Plan (or equivalent validation program) task sufficiently cover the intent of the dedicated task?

OEM must provide details in the L/HIRF Assurance Plan to satisfy the working group that the degradation concern is sufficiently covered. If the need for a task is based on unfavorable in-service experience, it is not a candidate for coverage by the L/HIRF Assurance Plan.

Step 18: Submit standalone task determined for inclusion in MRBR.

All L/HIRF-derived stand-alone tasks should be uniquely identified in the MRBR for traceability during future changes.

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Once the analysis is completed, the resulting maintenance tasks and intervals for all L/HIRF systems are submitted to the ISC for approval and inclusion in the MRB Report proposal.

Step 19: No standalone task required, monitor with an L/HIRF Assurance Plan (or equivalent validation program)

OEM must ensure traceability of all dedicated tasks covered by the L/HIRF Assurance Plan, until Engineering and the ISC have agreed sufficient data has been collected to determine permanent disposition of the recommended dedicated task.

NOTE: If an L/HIRF Assurance Plan is discontinued, OEM has responsibility to either use the collected data to support “No dedicated task required” or to institute the original dedicated task into the maintenance program.

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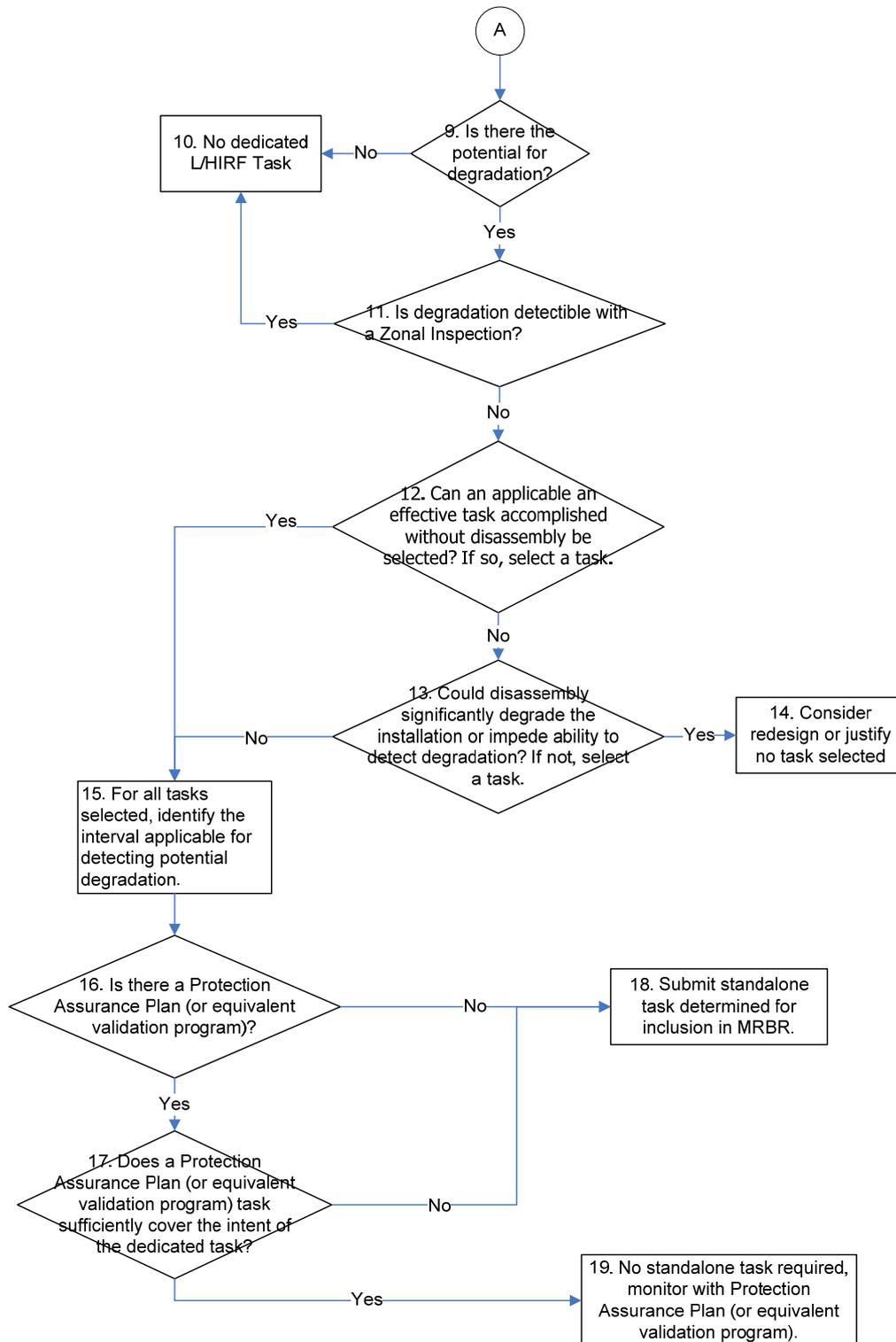
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Figure 2-6-1.3 L/HIRF Analysis Methodology Logic Diagram



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Glossary Additions:

Lightning/HIRF Significant Item: L/HIRF components are determined to be significant if they protect critical systems and structure as determined by engineering. A Lightning/HIRF Significant Item (LHSI) consists of aircraft system or structural Lightning/HIRF protection components or group of components in an installed environment. Components that make up LHSIs are selected using engineering judgment based on the anticipated consequences of the protection component degradation.

The LHSI list includes the aircraft critical system or structural L/HIRF protection components (examples can be bonding jumpers, connectors, and structural panels with protection) provided by the OEM Design Engineering team and any additional protection components added by the MSG-3 analyst. The LHSI list is analyzed through the MSG-3 logic process to determine initial L/HIRF scheduled maintenance requirements.

IMRBPB Position:

Date: April 25, 2013

Position: The IMRBPB has accepted the current text within this CIP, which was amended on April 25, 2013, to address the remainder of the FAA and TCCA L/HIRF comments concerning the assurance plan, level of analysis and good performance philosophy.

Prior to the use of this new L/HIRF process an agreement is to be reached with the manufacturer regarding the use of an assurance plan. If an assurance plan is to be used during the L/HIRF MSG-3 analysis the applicable PPH must be updated to include this agreement, which will indicate roles and responsibilities.

Note: flowchart 2-6-1.3 requires amendment to remove the word Protection from the assurance plan reference.

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Status of Issue Paper (when closed state the closure date): Closed as IP 129 April 26, 2013.

Recommendation for implementation: Implementation at the next revision of MSG-3 volumes I and II.

Important Note: The IMRBPB positions are not policy. Positions become policy only when the policy is issued formally by the appropriate National Aviation Authority.