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

Lightning/High Intensity Radiated Field (L/HIRF) protection systems have been identified for development of dedicated maintenance. The intent of this maintenance is to reduce the possibility that a single failure cause (such as a lightning strike), and the occurrence of a common failure cause (such as ED or AD) across redundant channels of L/HIRF protection, could impact aircraft airworthiness.

This section contains guidelines for development of scheduled maintenance tasks for aircraft L/HIRF Pprotection Ssystems. Each L/HIRF Pprotective Ssystem item is evaluated in terms of its susceptibility to degradation from environmental deterioration and/or accidental damage. The L/HIRF maintenance tasks are developed in support of the aircraft type certification and MRB report development.

Using a logic type analysis **based on the consequences of the protection's failure**, the Working Group determines the type of scheduled maintenance task that is both applicable and effective along with the frequency (interval) of the task.

~~**Lightning/High Intensity Radiated Field (L/HIRF) protection is rated for its criticality with respect to the consequences of the protection's failure.**~~

~~**L/HIRF maintenance is divided into two (2) distinct categories:**~~

1. ~~**L/HIRF Protection within LRUs (contained in the Component Maintenance Manual, CMM). 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.**~~

   ~~**The aircraft manufacturer will work with the suppliers of LRUs requiring L/HIRF protection to ensure that the CMM states the Supplier's maintenance philosophy to ensure the continued effectiveness of L/HIRF protective devices. The maintenance of this type of L/HIRF protection is not developed with the use of this document.**~~

2. ~~**L/HIRF Protection on the aircraft (developed during this MSG-3 process, and contained in the subsequent MRB Report). All Level A and B L/HIRF protection on the aircraft (any protection not within an LRU) that was identified during L/HIRF certification must be analyzed. Normally this includes 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.**~~

   ~~**Level A systems are electrical and electronic systems whose failure would cause or contribute to a failure of function resulting in a catastrophic failure condition of the aircraft.**~~

   ~~**Level B systems are electrical and electronic systems whose failure would cause or contribute to a failure of function resulting in a hazardous failure condition of the aircraft.**~~

L/HIRF maintenance relies on adequate protection provided by both external and internal L/HIRF protection components.

1. **Internal Line Replaceable Unit (LRU) L/HIRF Protection Components**
   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. These protection devices shall be maintained in accordance with the LRU manufacturer's recommendations. The development of

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manufacturer recommended maintenance is not accomplished utilizing the MSG-3 process.

2 **External On Aircraft L/HIRF Protection Components**

All L/HIRF protection on the aircraft (any protection not within an LRU) that was identified during L/HIRF certification as having an adverse effect on safety must be analyzed. Normally this includes 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.

2-6-1. L/HIRF Maintenance

L/HIRF maintenance analysis process shall select applicable and effective tasks for L/HIRF protection components that are susceptible to ED/AD. Where no dedicated maintenance is identified within the L/HIRF maintenance process, the Zonal tasks may be used to adequately maintain L/HIRF protection.

1. L/HIRF Protection Analysis ~~Focus~~Concepts

In ~~order to narrow the focus of the analysis~~**cases where no dedicated L/HIRF tasks have been selected**, the following concepts are accepted:

1 All visible L/HIRF protection (wires, shields, connectors, bonding straps, or raceways between connectors or termination points) is included in Zonal Inspections.

2 L/HIRF protection within conduit or heatshrink, is covered in the Zonal Inspections by confirming integrity of the protective covering.

3 **Maintenance of the i**nherent conductivity of the aircraft **metallic** structure is covered by the Zonal Inspections. Corrosion concerns are addressed by the Structural Inspections.

4 Composite fairings with conductive mesh are covered by the Zonal Inspections.

5 ~~Where the Zonal Inspections are not effective, additional analysis may produce other scheduled maintenance tasks.~~**Common mode degradation in a localized area is considered in the analysis process.**

2. L/HIRF Protection Analysis Ratings

L/HIRF protection requires an analysis for the effects of Environmental Deterioration (ED) and Accidental Damage (AD) to determine ~~what maintenance will effectively detect degradation~~ **the likelihood of component degradation based on the environment in which the component is installed.**

Environment - consider the effects of the atmosphere, corrosive products, condensation, temperature, and vibration on the protection, with respect to degradation.

Susceptibility to Damage - consider the likelihood of damage during maintenance or damage during operations. Examples would be areas where connectors could be stepped on, or effects of de-icing fluid on a connector during winter operations.

3. L/HIRF Protection Analysis Process and Flowchart (see Figure 2-6-1.3)

1) Provide a description of the L/HIRF protection systems and assemble a list of L/HIRF protection components by zone whose failure could have an adverse effect on safety. Protection within a given zone

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should include both electrical and non-electrical protection components. Create a matrix that lists the location of each component within the zone. Examples of electrical components include: Wire shielding, pigtail terminations, backshells, bonding straps, etc. Examples of non-electrical components include: metallic meshes, raceways, conductive gaskets, conductive coatings, structure and substructure, etc.

2) **Provide the component characteristics and applicable performance data (if available) for each protection component within a zone. Protection component characteristics are properties that are relied upon to provide L/HIRF protection such as resistance to corrosion, effects of environment and robustness of design. Examples of applicable performance data include: developmental data, qualification test data, in service data etc.**

3) **Identify potential degradation of the characteristics for protection components within the zone. Describe the zone environment. This should include considerations of surrounding (adjacent/above/below) zones that may have an impact on the zone environment. Define each protection component degradation and applicable test data, if available, that identified the degradation. Also include any in-service experience that may have been accumulated from similar protection components currently in-service for each degradation type. In-service includes data gathered during maintenance or performance validation tests. Details associated with the level of degradation and types of degradation are also included in this step in order to benchmark expected in-service performance. (Note: An engineering validation program may be utilized to gather in-service data for maintenance programs and validating the design. Results of such an in-service validation program may be provided as part of updates to the MSG-3 analysis and maintenance program. This data can be analyzed, evaluated, and interpreted by the OEM engineering team for use in determining protection improvements and/or maintenance program adjustments.)**

4) **Are characteristics of the protection components susceptible (i.e., particularly sensitive) to Environmental Deterioration and Accidental Damage (ED/AD)? A process will be developed and utilized by the working group to determine a rating of the susceptibility of the protection components to ED/AD.**

5) **No dedicated L/HIRF maintenance task selected.**

6) **Will the failure condition due to the expected degradation in combination with a L/HIRF event prevent the continued safe flight and landing of the aircraft?**

7) **Select applicable and effective L/HIRF maintenance task and interval to detect degradation. Using best judgment and available information, the task and assigned interval must reduce the risk of failure to assure safe operation.**

8) **Was a task identified? (self-explanatory)**

9) **Is the task a GVI? (self-explanatory)**

10) **Is the selected task appropriate for transfer to the Zonal Inspection Program? Determination of appropriateness uses interval, access, visibility or other means. Refer to Zonal Analysis Procedures section of the MSG-3 document.**

11) **Zonal Inspection Candidate. (self-explanatory)**

12) **Dedicated L/HIRF maintenance task. This task is listed as part of the L/HIRF maintenance program.**

13) **Redesign is mandatory. In cases where applicable and effective maintenance cannot be selected to identify the degradation event during a maintenance action, redesign is required.**

14) **Select applicable and effective L/HIRF maintenance task and interval to detect degradation. Using best judgment and available information, the task and assigned interval must reduce the risk of failure to**

assure safe operation.

15) Was a task identified? (self-explanatory)

16) Dedicated L/HIRF maintenance task. This task is listed as part of the L/HIRF maintenance program.

Figure 2-6-1.3. L/HIRF Process Flowchart

(see IP #80 IMRBPB Action Item 0510 attachment2)

4. Flowchart Description

The following is the intent of each block of the flow chart that follows:

Block 1 - "Aircraft L/HIRF Protective Systems"
Self-explanatory; flow diagram "Title" block.

Block 2 - "Define Aircraft Zones"
Prior to accomplishment of L/HIRF analysis, it is necessary to have the Zones defined.

Block 3 - "Define Level A and B" Defining what systems are Level A or Level B is a separate process from MSG-3, and is usually derived from a separate engineering report

Block 4 - Is it a Level A or B?"
Analysis for Level A will follow a separate flow path from Level B.

Block 5 - "Determine Inspection" L/HIRF analysis will use an ED/AD assessment to determine task and interval for L/HIRF protection maintenance.

Block 6 - "Are Zonal Inspection Tasks Applicable and Effective?"
Wherever possible, credit will be taken for Zonal Inspections.

Block 7 - "Covered by Zonal Maintenance"
Assessment shows the Zonal Inspections are effective.

Block 8 - "Is Protection Similar?" Is it possible to take credit for similar protection that has been evaluated to be effective on similar type aircraft?

Block 9 - "Manufacturer's Maintenance" If there is no similar protection installed on another aircraft, the manufacturer can choose its own method for task determination on Level B systems.

Block 10 - Working Group Recommendations"
Incorporation of the Working Group's recommendations.

Block 11 - "L/HIRF Maintenance"

~~All tasks roll into the L/HIRF Maintenance.~~

~~Figure 2-6-2.1.L/HIRF Logic Diagram~~

4. Analysis Approval

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.

==========

(move into Glossary)

L/HIRF Protection Systems - Systems comprised of components that avoid, eliminate, or reduce the consequences of an L/HIRF event.

L/HIRF Protection Component - any self-contained part, combination of parts, subassemblies, units, or structures that perform a distinctive function necessary to provide L/HIRF protection.

L/HIRF Characteristics - those properties of L/HIRF protection components that are necessary to perform their intended L/HIRF protection function(s).

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The aircraft manufacturer will work with the suppliers of LRUs requiring L/HIRF protection to ensure that the CMM states the Supplier's maintenance philosophy to ensure the continued effectiveness of L/HIRF protective devices. The maintenance of this type of L/HIRF protection is not developed with the use of this MSG-3 documen

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on the aircraft (developed during this MSG-3 process, and contained in the subsequent MRB Report).

Page 2: [3] Comment [k2] **kvp1560** **03/01/2275 15:08:00**

Is this intended to include components whose degradation could cause or contribute to a Major Failure condition as well? As, are currently not covering these failure modes with the current analysis process.

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The scheduled maintenance analysis process must cover all non-economic

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L/HIRF protection components. The majority of this protection ~~will~~ **may** be covered through the Zonal Inspections

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Where[z1] this Zonal maintenance will not adequately identify degradation of the L/HIRF protection, additional scheduled maintenance may be generated based on the likelihood of ED or AD.

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This mistakenly seems as though the identification of zonal items comes first in the methodology.

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the analysis of L/HIRF protection components

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This does not apply to composite aircraft, or does it?

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Page 2: [15] Comment [z6] **zz540a** **12/15/2274 08:16:00**

This implies that you research what can go into zonal without guidelines. I recommend that we delete it.

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Where[z2] the Zonal Inspections are not effective, additional analysis may produce other scheduled maintenance tasks.

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This is the “old” probability of failure is “1”.

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what maintenance will effectively detect degradation

Page 2: [19] Comment [k8] **kvp1560** **03/01/2275 20:60:00**

Do we need additional words here, now that we are working the process?

Page 2: [20] Comment [z9] **zz540a** **09/01/2007 22:44:00**

Add above the correlation to the figure.