International Maintenance Review Board Policy Board (IMRBPB)

Issue Paper (IP)

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Retroactivity (Y/N): N

Title:	The role of an L/HIRF assurance program in MSG-3
Submitter:	EASA

Applies To:	
MSG-3 Vol 1	X
MSG-3 Vol 2	X
IMPS	

Issue:

Clarification of a conflict between current MSG-3 and certification guidance material wording

Problem:

In the current MSG-3 L/HIRF logic introduced with MSG-3 Revision 2013.1, the fact that an LHSI is covered by an L/HIRF Assurance Plan (or equivalent validation program), can be used to justify that the protection component is sufficiently covered, and *no standalone task is required*, monitoring the item with Assurance Plan (or equivalent validation program) is sufficient.
(Decision Box 17 and Box 19 of Figure 2-6-1.3, Step 17 and 19 of chapter 2-6-1.3)

Certification guidance material (e.g. FAA AC 20-158A , EASA AMC 20-158, SAE ARP 5415B, EUROCAE ED-107A) however states:

" Appropriate maintenance procedures should be defined for these devices and features to ensure in-service protection integrity. ***A HIRF protection assurance programme may be necessary to verify that the maintenance procedures are adequate.*** *"*

(Note: AC 20-136 / AMC 20.136 cover lightning separately, so the assurance program mentioned in the above documents is only called HIRF assurance program, but similar wording exists for a lightning assurance program).

So the idea of the L/HIRF assurance plan is to verify that the selected L/HIRF maintenance tasks are indeed effective. The introduction of some existing assurance plans of major airframe manufacturers do state the same.

So using the L/HIRF assurance plan, intended to verify the maintenance tasks, to justify that no maintenance tasks are required is against the philosophy of this plan.

The current wording of MSG-3 also implies that the L/HIRF Assurance Plan will monitor all the LHSIs, while in fact only very small sample of components is indeed covered.

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However, also the Zonal Program as developed during the MRB process using MSG-3 formally is scheduled maintenance, and an L/HIRF assurance program may verify that LHSIs are appropriately covered by a Zonal GVI, with no standalone task created.
So in fact what MSG-3 currently calls "no dedicated task" means that the item is maintained through the Zonal Program.

With MSG-3 Rev. 2013 the formal transfer of L/HIRF tasks to the Zonal Program has been deleted, however if we want to avoid to create a dedicated L/HIRF based on an Assurance Program, which according to the certification terminology shall validate that the items are appropriately covered by maintenance, than we must not only check that the according item is covered by the assurance program, but also that it is adequately covered by the Zonal Program.

Note that ARP 5415B makes reference to the fact that the maintenance program activities may not directly determine the HIRF protection effectiveness, but may look for indirect indications that would represent degradation. For example, visual inspections may look for connector corrosion that would indicate the potential for increased shield bonding resistance. But the shielding effectiveness itself can only be determined by direct measurement, which may be accomplished by the assurance program.

The extent of the surveillance program depends on the scope of the aircraft maintenance program. A surveillance program is needed if the maintenance program does not directly determine the effectiveness of the HIRF protection. For example, if the maintenance program relies upon visual inspections to determine if wire shielding or raceways continue to provide effective protection, then the surveillance program should include direct measurements on an agreed-upon set of protection features.
In contrast, if the maintenance program incorporates direct measurement of the protection elements, then the surveillance program may not be required for these elements.
Again, an example is if the maintenance includes shield and connector loop resistance measurements, a surveillance program is not necessary for the shield and connector protection effectiveness, and may only be used to establish applicable inspection intervals.

This philosophy is currently not clear in the selected MSG-3 wording, The note in Step 13 somehow addresses this topic, but is not widely understood.

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Recommendation (including Implementation):

Harmonize the wording between MSG-3 and certification guidance material and rename the L/HIRF assurance *plan* to L/HIRF assurance *program*. It is understood that at the time of the initial MRB the assurance program is potentially still a plan, however to be effective it has to finally become a program.

Clarify that an L/HIRF assurance plan is not the replacement for a task, but potentially a way to allow for simpler tasks (e.g. just checking for the external condition of items to detect hidden internal deterioration), or potentially for covering the LHSI by the Zonal program.

As certification covers lightning and HIRF by separate requirements and guidance material, clarify the MSG-3 term L/HIRF.

Amend MSG-3 Revision 2018.1, Volume 1 and Volume 2, Para. 2-6. 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 L/HIRF analysis is a collaborative effort between the OEM Design and Maintenance Engineering groups and the Working Group, which reviews the L/HIRF protection LHSIs 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.

    a. Line Replaceable Unit (LRU) Internal 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.

    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.

b. External On Aircraft L/HIRF Protection Components

L/HIRF protection (any protection not within an LRU) protecting systems, structures, engine, piping & ducting etc. from direct and indirect effects of lightning and/or HIRF, 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~~ Program Philosophy

L/HIRF Assurance ~~Plans~~ Programs, as explicitly addressed in industry and authority guidance material, 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.~~

An L/HIRF Assurance Program can be used to

- Validate the performance and operating environment assumptions
- Validate that the MSG-3 derived L/HIRF tasks and intervals (where selected) are providing for an effective maintenance program that allows to maintain the required protection for the life of the aircraft
- Validates that the Zonal Inspections do effectively cover those LHSIs without dedicated L/HIRF task
- Validate that selected external inspections for indication of internal deterioration are indeed effective
- Detect unexpected degradation (modes and/or rate)
- Validate that modification or standard repair/replacement did not affect the assumed performance
- Collect in-service maintenance data to support later optimisation of the design or the maintenance requirements (including support to IP44 exercises)
- Collect in-service maintenance data to support new aircraft model analysis

It should be understood that the assurance program does not replace MSG-3 tasks or allow for assumptions beyond what can be justified at the time of the analysis. Any decision taken in the course of the L/HIRF analysis should be duly justified, it may still be necessary to verify them in real service. However, in specific cases, 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 Program rather than by scheduled L/HIRF tasks derived by MSG-3 analysis.

As failure of L/HIRF protection components typically remains hidden until a relatively rare lightning or HIRF event is encountered, we can not rely as much on unscheduled findings as we can do for many systems or structures components. To confirm that the LHSI do perform as expected, this needs to be explicitly verified by dedicated tasks. These tasks may require a more sophisticated examination than the scheduled MSG-3 tasks (e.g. conductivity tests requiring disassembly, impedance tests). The L/HIRF Assurance program is an effective means to provide systematically for such sampling tasks.

As the L/HIRF Assurance Program (or equivalents) are not originating from the MSG-3 analysis, the OEM has to provide all program information to the working group and/or include it in the according LHSI analysis.

Normally the L/HIRF Assurance Program, if in place, should continue for the life of the fleet.

Results from Assurance Program, as well as changes to the Assurance Program should be reported back to the MRB process to allow to assess the selected tasks impact.

3. Good Performance Philosophy

OEMs may prepare a list of ~~LHSIs~~ L/HIRF protections identified as or as part of an LHSI 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).

If good performance is expected purely based on theoretical assessment (e.g. relative design comparison) or laboratory testing and not on in-service maintenance experience with similar aircraft, additional monitoring by the L/HIRF Assurance Program may be necessary to validate the expectation.

Amend MSG-3 Revision 2018.1, Volume 1 and Volume 2, Para. 2-6-1.3. Step 9, Step 10 and Step 11 as follows:

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

Step 9: Is there the potential for degradation?

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

The mode and rate of degradation or the fact that a component is not expected to deteriorate may be confirmed through the L/HIRF Assurance Program if no relevant in-service maintenance experience covering the full aircraft life is existing.

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.~~

The according LHSI does not require a dedicated L/HIRF Task, but is still covered through Zonal inspections if it is visible.

Additionally monitoring through the L/HIRF Assurance Program may be necessary for items not visible.

Step 11: Is degradation detectible with a Zonal Inspection?

In this step it should be distinguished between degradation directly visible (e.g. a corroded or broken bonding strap, chafed wire braid) and externally visible deterioration which is a reliable indication for internal degradation (e.g. an externally corroded backshell may indicate degradation of the internal grounding of the wire shielding).

The L/HIRF Assurance program may provide confirmation that internal degradation can be reliably detected through externally visible indications.

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

Amend MSG-3 Revision 2018.1, Volume 1 and Volume 2 Appendix A. (Glossary) as follows:

L/HIRF	A term combining the aspects of direct and indirect effects of Lightning (L) and ~~/~~High Intensity Radiated Field (HIRF)
L/HIRF Assurance Program	A fleet level sampling program of dedicated tasks (e.g. circuit impedance measurement, resistance measurement) to verify that the maintenance program adequately ensures in-service integrity of L/HIRF protection components over the life of the aircraft
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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Recommendation for Implementation:	

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