

Issue Paper (IP)

IP Number: CIP MPIG-2025-01

Initial Date: (DD/MMM/YYYY): 18/Feb/2025

Revision / Date: (DD/MMM/YYYY): 24/Mar/2025

Effective Date: (DD/MMM/YYYY): TBD

Retroactivity (Y/N): N

Title:	Assessment of electric propulsion High Voltage wiring in MSG-3
Submitter:	MPIG

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

Issue:

The current assessment of wiring in MSG-3 considers the concept of the Enhanced Zonal (EZAP), when assessing EWIS. The method has shown to be efficient to consider the effects of fire in zones where combustible materials and wiring co-exist, in order to identify scheduled maintenance requirements to minimise the accumulation of combustible materials and improves the likelihood that EWIS degradation will be identified and corrected, thus preventing an ignition source.

The current methodology is efficient for aircraft types where high voltage is not employed for electric propulsion and meets the intent of the regulation for transport category aircraft. Nonetheless, it may not consider the higher energy available on high voltage systems, in particular to electric propulsion systems.

High Voltage employed on high energy wiring systems have the potential, if failed, to damage surrounding equipment and structure irrespective of the presence of combustible material in a Zone. Electrical arcing events of high voltage systems may release more energy than the traditional wiring found on 115/200 VAC, 400 Hz systems. Arcing to composite structures, for example, can damage the structure by causing localised heating and potentially leading to delamination of the composite structure. Since the risk of arcing increases with higher voltages and the high voltage circuit protections for electric propulsion differs from the high voltage circuits employed to other uses, the MSG-3 methodology should be revisited to ensure scheduled maintenance requirements are properly considered for aircraft designs where high voltage is employed for electric propulsion. It is important to note that the EWIS architecture may mitigate the probability of arcing, which should be considered by the maintenance engineer when performing the analysis.



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The term ‘High Voltage’ would require a threshold definition in the context of MSG-3 in addition to the proposed methodology changed in this Issue Paper. SAE AIR7502 - Aircraft Electrical Voltage Level Definitions, defined different levels of voltage as per the table summary below (presented in SAE AIR7374 - Aging Mechanisms of Electrical Insulation Materials in a High Energy System):

Voltage Level	AC Nominal, V-RMS (LN)	DC Nominal, VDC
VL-1	Up to 42.4 VAC	Up to 60 VDC
VL-2	42.4 to 213 VAC	60 to 300 VDC
VL-3	213 to 425 VAC	300 to 600 VDC
VL-4	425 to 707 VAC	600 VDC to 1.0 kVDC
VL-5	707 VAC to 3.6 kVAC	1.0 to 5.1 kVDC
VL-6	Above 3.6 kVAC	Above 5.1 kVDC

Ref: SAE AIR7374, Issued 2024-02, Table 1.

The Recommendation section provides the definition, based on VL-3 level from SAE AIR7502, when applied to electric propulsion wiring systems.

Problem:

MSG-3 does not provide guidance to assess high voltage wiring and identify the initial minimum maintenance requirements in a way that is commensurate with the potential effects of its failures for electric propulsion aircraft systems. Current wiring assessment within EZAP is related to preventing ignition sources to areas where combustible materials could accumulate or based on its proximity to other essential systems such as hydraulic systems and flight controls.

With electric propulsion systems in particular, high voltage wiring is more present than in combustion propulsion aircraft, and those circuits employ different protection devices than traditional loads for low voltage or high voltage circuits. In such cases, failures of the high voltage wiring system may affect the surrounding structure and equipment irrespective of the presence of combustible materials in the affected zone if a failure (or combination of failures) occurs.

It is important to note that some failure modes related to wiring age, won't be inspectable (corona effect within the conductors). The mitigation for those failures, if required, is driven by engineering requirements resulting in wiring life limits determined outside of the scope of MGS-3.

Recommendation (including Implementation):



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It is recommended to use the Zonal analysis framework to address electric propulsion high voltage wiring failures, leveraging the existing framework created to consider EWIS degradation and preventing ignition sources in zones with combustible materials.

The recommendation consists in ensuring the assessment of electric propulsion high voltage EWIS is assessed for loss of separation or isolation from aircraft structure or surrounding equipment, should one EWIS element fail.

1. Update the MSG-3 document Figure 2-5-1.1. Zonal MSG-3 Logic Diagram adding the elements in blue in the revised flowchart below.
 - a. Rationale: The proposed changes would allow the assessment and task identification for electric propulsion EWIS elements, without disrupting the current EZAP process that is referenced and relied upon to meet some certification requirements and guidelines (e.g. FAA AC 25-27);
 - b. The change ensures the creation of a dedicated EWIS elements failure assessment for electric propulsion HV EWIS elements within a zone.
 - c. A task would be selected should one EWIS element failure (isolation, clamp, etc) cause the loss of separation between the electric propulsion HV EWIS wiring and surrounding structure or equipment.
 - d. The HV wiring would still be considered in the EZAP framework as any other wiring currently.
2. Update the MSG-3 document Figure 2-5-1.1. Zonal MSG-3 Logic Diagram to replace the word ‘inspection’ or ‘inspection task’ with ‘task’.
 - a. Rationale: the Electric Propulsion High Voltage EWIS task may range from visuals inspections to functions checks. Therefore, in order to maintain the Zonal workflow still applicable to this change, the word ‘inspection’ should be replaced. The change does not adversely affect the current EZAP methodology.
3. Update the MSG-3 document Figure 2-5-1.1. Zonal MSG-3 Logic Diagram to replace ‘Stand-alone GVI, DET’ with ‘Stand-alone tasks’.
 - a. Rationale: the Electric Propulsion High Voltage EWIS task may range from visuals inspections to functions checks, and those would be considered stand-alone tasks in the MRBR/MTBR. The change does not adversely affect the current EZAP methodology.
4. Amend MSG-3 Document section 2-5-1. “Procedure”, adding paragraph “1” as follows:
 1. For zones containing electric propulsion High Voltage EWIS, a dedicated task is to be created for the high voltage EWIS when the failure of one EWIS element (including within the same bundle, i.e. isolation causing arcing) causes the loss of separation or isolation between the electric propulsion HV wiring and surrounding structure or equipment. The same wiring and zone will be assessed for accumulation of combustible materials, ignition source and proximity to components by continuing the process flowchart. The task scope, type and interval



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will be proposed by the TCH based on the expected failure mode, existing in service or test data. The selected task should be considered a stand-alone task in the System and Powerplant Section of the MRBR/MTRB. Note that unlike the EZAP task selection, the WG may select other task types in addition to GVIs or DETs.

5. Amend MSG-3 Document Appendix A. Glossary to add definition of High Voltage EWIS:
***Electric Propulsion High Voltage EWIS:** EWIS elements carrying single phase AC voltages greater than 213 Volts rms or DC voltages greater than 300 VDC (line to ground for unipolar, or between two lines for bipolar) used to power electric propulsion elements.*



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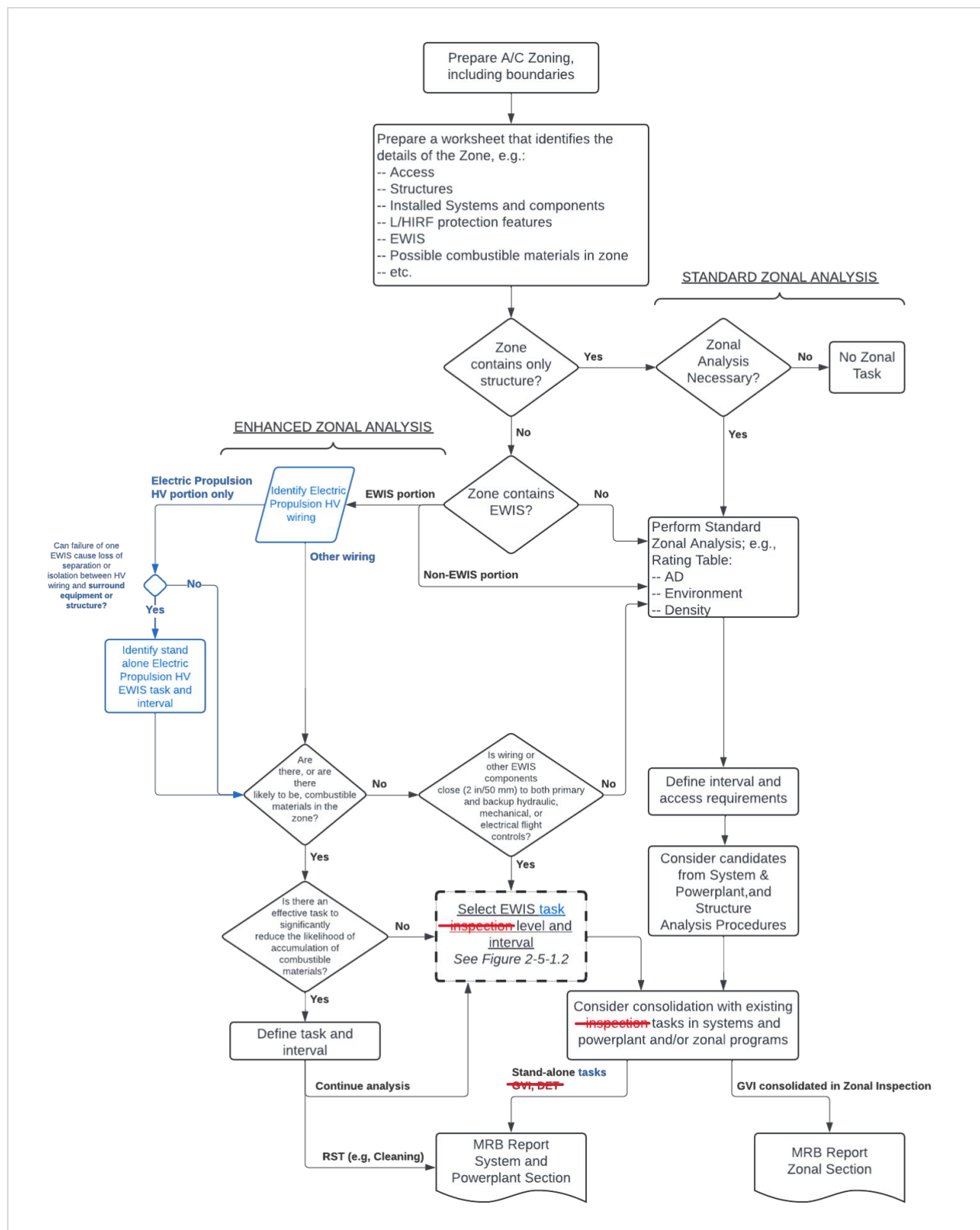
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IMRBPB Position:	
Date:	
Position:	
Recommendation for Implementation:	

Status of the Issue Paper:	<input type="checkbox"/>	Active
	<input type="checkbox"/>	Incorporated in MSG-3 / IMPS (with details)
	<input type="checkbox"/>	Archived