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| **NASA Expendable Launch Vehicle (ELV)**  **Payload Safety Hazard Report**  (NPR 8715.7 and NASA-STD 8719.24) | | | 1. HAZARD REPORT #:  **MERV-PROP-01**  2. INITIATION DATE:  08/12/2014 |

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| 3. MISSION/PAYLOAD PROJECT NAME:  MERV  PAYLOAD SYSTEM SAFETY ENGINEER:  Lucas Layman | | | 4. REVIEW PHASE:  ☒ Phase I  ☐ Phase II  ☐ Phase III |

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| 5. SYSTEM/SUBSYSTEM:  Propulsion  Structure  Propellants | | 6. HAZARD GROUP(S):  Fire/Explosion  Pressure | 7. DATE:  08/12/2014 |

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| 8. APPLICABLE SAFETY REQUIREMENTS:  N/A | | | |

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| **HAZARD** | | | |

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| 9. HAZARD TITLE: | | 10. HAZARD CATEGORY AND RISK LIKELIHOOD: | |

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| Failures of Upper Stage during USE operations that lead to USE Cavitation/Fire/Explosion | | ☒ I - Catastrophic  ☐ II - Critical  ☐ III - Marginal  ☐ IV - Negligible | ☐ A - Frequent  ☐ B - Reasonably probable  ☒ C - Occassional  ☐ D - Remote  ☐ E - Extremely improbable |

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| 11. DESCRIPTION OF HAZARD:  The Upper Stage is responsible for supply of propellants (LH2 and LO2) to the USE during operation. Failures after USE start that result in a decrease or termination of flow to the USE will cause USE turbopump over speed/cavitation/damage leading to an explosion. If Upper Stage fails to command USE shutdown, propellant depletion could occur also leading to cavitation. A decrease in Net Positive Suction Pressure (NPSP) or blockage in the feedlines could decrease flow and inadvertent closure of the prevalve would terminate flow. Ingestion of ullage gas in the feed line will also cause turbopump cavitation. Ullage gas could be ingested if a vortex forms or propellant is depleted. Contaminates that enter the USE inlet could cause significant damage. | | | |

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| 12. HAZARD CAUSES:  Cause 1 – Improper feed system design leads to incorrect pressures or temperatures during USE run  Cause 2 – Depleted propellants  Cause 3 – Loss of fuel and/or oxidizer supply  Cause 4 (TRANSFER): MERV-PRESS-02 – Failure to Maintain Liquid Hydrogen Propellant Tank Pressure leads to USE operational failure  Cause 5 (TRANSFER): MERV-PROP-04, Cause 1 – POGO causes dynamic oscillations attaining a resonant frequency with other US components or USE | | | |