

Risk Analysis Associated with Loss of Toxic Gases during Orion Landing and Recovery Operations

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Mission, landing and recovery operations for the Orion crew module involve reentry into the Earth's atmosphere and the deployment of three Nomex parachutes to slow the descent before landing along the west coast of the United States. Orion may have residual fuel (hydrazine, N_2H_4) or coolant (ammonia, NH_3) on board which are both highly toxic to crew in the event of exposure. These risks were evaluated using a first principles analysis approach through fluid dynamics modeling. Plume calculations were first performed with the ANSYS Fluent computational fluid dynamics code. Data were then extracted at locations relevant to crew safety such as the snorkel fan inlet and the egress hatch. Mixing calculations were performed to quantify exposure concentrations within the crew bay before and during egress and departure. Finally, results included herein were used to inform the Orion post-landing Concept of Operations (ConOps) so that strategies could be formulated to maintain crew safety in the event of the loss of fuel or coolant.

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