

Title: Gateway Integrated ECLSS Model Analysis of Intermodule Ventilation Failures

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The Gateway Integrated ECLSS Model (GIEM) is a set of two independent models, made in Aspen Custom Modeler (ACM) and Thermal Desktop (TD), of the Gateway stack and each modules' associated environment control and life support system (ECLSS). The GIEM utilizes the 41-Node Metabolic Man (METMAN) to simulate crew inside the Gateway consuming O₂ and producing CO₂, H₂O, and heat for the ECLSS to remove. The modules and visiting vehicles all have different levels of ECLSS capabilities and may rely on other modules and Intermodule Ventilation (IMV), which is used to exchange gas between the modules, to ensure the entire Gateway environment is controlled. If IMV were to fail or be turned off, some vehicles may have limited access to necessary ECLSS functions. This analysis focuses on evaluating O₂, CO₂, and H₂O levels when crew are in vehicles without their own life support and IMV has failed to evaluate how long before the atmosphere is unsafe for the crew. This analysis uses the integrated nature of the GIEM to look at time to effect for O₂ depletion and CO₂ and H₂O buildup when crew are working in vehicles that have been cut off from the ECLSS-active portion of the stack. This information is used to inform for how long crew can safely continue working in the ECLSS-inactive vehicles before experiencing a requirement violation or physical limitation and can be referenced when developing maintenance and emergency response concept of operations (ConOps).