

Hypoxia Risk Directed Acyclic Graph Narrative

- ❖ **Hostile Closed Environment** is the primary spaceflight hazard requiring NASA to create an engineered atmosphere optimized for mission success.
- ❖ **Altered Gravity** leads towards negative physiologic changes in the body and so does hypoxia, therefore any nominal hypoxia must be driven by operational needs and minimized.
- ❖ There are two levels of **Hypoxia** stemming from different sources that are concern in spaceflight. The **Hypoxia** node represents more severe hypoxia that can occur as a result of a **Suit Failure**, **Toxic Exposure**, or **Depressurization** from **Vehicle Failure**. This severity of hypoxia can lead to **Loss of Crew Life** or can impact **Individual Readiness** and **Crew Capability**.
- ❖ **Mild Hypoxia** is a different concern that can lead to issues with **Cognitive Function**—which is affected by **Individual Factors**—Fatigue, Exercise Prescription, and **Medical (Risk)** conditions such as acute mountain sickness, and issues addressed by other Human System Risks including **DCS (Risk)**, **Immune (Risk)**, **SANS (Risk)**, **Sleep (Risk)**, and **Muscle/Aerobic (Risk)**.
- ❖ **Atmospheric conditions** (specifically low pressure) can affect food processing (converting raw ingredients such as soybeans into tofu) or food preparation beyond simple heating and rehydration is conducted. This concern will be addressed by the Food and Nutrition Risk Team.
- ❖ **Mild Hypoxia** is of concern when considering Exploration Atmospheres for example, where changes to **Atmospheric Conditions** during **Staged Denitrogenation** can expose astronauts to physiologic hypoxia that is at a low level and chronic over time. **Suit Failures** that are not catastrophic can also induce **Mild Hypoxia** and these can be caused by either **Suit Design** issues or **EVA Operations**. The level of hypoxia experienced is also dependent on the **Effective Exposure Duration**.
- ❖ **Distance from Earth** affects the available mass, power, volume and bandwidth available to a **Crew Health and Performance System**. Issues addressed by the **EIHSO (Risk)** contribute to **Vehicle Design** and capabilities of the **Crew Health and Performance System**, which enables **Environmental Monitoring Capability** that can **Detect Atmospheric Changes**. In cases where those changes warrant, countermeasures such as **Breathing Masks**, **Pressure Suits**, and **Compartment Isolation** can be implemented to protect **Individual Readiness**, **Crew Capability**, and health.

- ❖ Historically pilots and astronauts are exposed to hypoxic conditions prior to flight so that they can understand how their unique symptoms are expressed. This is because the insidious onset of hypoxia can affect **Individual Readiness** and **Crew Capability** severely enough that **Task Performance** for critical tasks like piloting a vehicle may be affected and **Loss of Vehicle, Loss of Mission Objectives, or Loss of Mission** can occur.

