**Updates to NASA’s Break-in-Prebreathe Rules Due to Type II Decompression Sickness Risk Considerations**

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**INTRODUCTION.** Investigation of a central neurological decompression sickness (DCS) case during ground testing at Johnson Space Center identified a break-in-prebreathe (BIP) 13 minutes prior to depressurization as the leading credible cause despite applicable prebreathe payback rules being followed. Applicable NASA rules, for ground and flight, directed 2:1 payback of breaks up to 10 mins in duration, regardless of when a break occurs relative to depress. Full restart of prebreathe is directed following breaks > 10 min. The adequacy of NASA’s BIP rules was evaluated prior to resuming hypobaric ground testing or ISS extravehicular activities.

**METHODS.** The following information sources were reviewed prior to formulating recommendations: i) Type II DCS case report and investigation findings; ii) documented rationale for existing flight rules, iii) consultations with subject matter experts involved in definition of existing flight rules (several of whom had since left NASA), iv) relevant published literature, v) model estimates of tissue on-gassing and off-gassing, and vi) NASA’s operational experience with late breaks in prebreathe.

**RESULTS.** NASA’s nominal prebreathe protocols are validated via extensive ground testing to ensure DCS risk is reduced to within acceptable limits. Conversely, there exists a paucity of data, no validated models, and limited documentation regarding BIP risk for NASA prebreathe protocols. Flight rules implemented for shuttle and later ISS are based primarily on expert opinion and an assumption of symmetric on-gassing and off-gassing, which would make 2:1 payback a conservative mitigation for a BIP. Assumption of exponential gas kinetics makes late breaks higher risk, or require greater payback, than earlier breaks. Two BIPs have occurred using the current ISS prebreathe protocol, each of which was followed by greater than 2:1 payback and at least 59 minutes of 100% O2 pre-depress. No DCS cases have been reported during shuttle or ISS EVA operations.

**DISCUSSION.** Interim changes were implemented to protect against late breaks during ground and flight prebreathes by ensuring negligible difference in conservatively modeled ppN2 pre-depress compared to nominal validated protocols. Additional documentation and literature review as well as chamber test planning are ongoing with the objective of further ground and flight rule updates and validation of a BIP risk model.