B&P Project 23-1: Hydrazine Measurement Safety Upgrade for the Applied Chemistry Laboratory

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e-NTR: 1730396079

Start TRL: 3 **End TRL:** 5

Prime STMD Taxonomy: TX06.4.1 Sensors: Air, Water, Microbial, and Acoustic Sensors

Secondary STMD Taxonomy: TX08.3.4 Environment Sensors and TX13.4.5 Operations, Health, and Maintenance for Ground and Surface Systems

Project Description: For several decades, NASA KSC has used a coulometric method for quantification of low-level concentrations of hydrazine and monomethylhydrazine (MMH), that are used for calibration and verification of sensor performance. The basic method was developed in the 1990's, and has been optimized over the past 30 years. In the most basic terms, hypergolic fuel vapor streams are generated and captured using 0.1 M sulfuric acid solution in a sampling impinger. Specific volumes of vapors are captured, then subjected to coulometric titration to determine the specific concentration of the vapor stream. The coulometric method has a theoretical limit of detection of less than 25 ng per 40 mL of solution, which corresponds to less than 2 ppb of hydrazine in 10 L of air. Hypergolic fuel vapor streams are generated using Kin-Tek Gas Standard Generators utilizing either refillable or disposable permeation tubes. At the start of this project, the limits of reliable and accurate fuel vapor generation at KSC were 26 ppb for the Components Refurbishment and Chemical Analysis (CRCA) Facility and approximately 50 ppb for the Applied Chemistry Laboratory (ACL). This work aims to advance the accurate fuel vapor generation and detection capabilities at KSC by updating and optimizing the fuel vapor generation and detection processes. Once the improved fuel vapor generation and detection processes are verified, any information gained during the proposed effort will be transferred to CRCA to improve their fuel vapor generation and quantification capabilities.

Project Closeout Summary: The work resulted in a successful design, fabrication, and demonstration of a modernized fuel vapor and generation system capable of generating and measuring 10 ppb levels of hypergolic fuels reliably. The project's TRL was advanced from a low-level of 3 to about a level of 7. The lowest concentration of hydrazine that was able to be generated was approximately 4 ppb, below the goal of 10 ppb. Two coulometer units were constructed and operated with limits of hydrazine detected at 0.88 and 0.38 ppb, as well as a software package for increased ease of use, and data analysis capabilities. However, further work is needed in order to improve the generation and quantification methods for these very low levels since generating stable low-level concentrations of hypergolic fuels is still challenging and meticulous. The project resulted in an e-NTR 1730396079 (Hydrazine Coulometer Improvements) and a presentation at the 2024 JANNAF (Joint Army Navy NASA Air Force) Conference held December 9-13, 2024, in Charlotte NC.