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ABSTRACT :

The US Army is researching Low GWP alternatives for fire suppression applications in weapon systems which includes those used in aviation powerplant compartments. Several sets of circumstances aligned recently to support a preliminary investigation of a possible powerplant halon-replacement candidate that is a blend of sodium bicarbonate and bromotrifluoropropene [2-BTP]. These circumstances relate to previous US Army efforts, 2-BTP, and a generic nacelle fire simulator [gNFS] located at the WJ Hughes FAA Technical Center [FAATC]. Previously, the US Army successfully worked through the challenges of development of a replacement for the hand-portable halon 1301 fire extinguisher located in its legacy aviation weapons system crew compartments. This replacement (still in the fielding phase) incorporates a blend of heptafluoropropane [HFC-227ea] and a “small”-particle sodium bicarbonate. These circumstances offer a premise that a blend of a less-efficient halon-replacement candidate and sodium bicarbonate can produce an effective solution to the halon-replacement challenge. Additionally, at this time and as many have noted, bromotrifluoropropene [a] is capable of extinguishing combustion and [b] appears environmentally benign when considering the current constraints of ozone depletion & global warming. However, in contrast, 2-BTP also offers challenges in terms of [a] a witnessed unfavorable behavior of enhancing combustion in certain conditions and [b] its thermodynamic properties may not favorably align with aircraft operational envelopes. Lastly, a test environment existed that allowed this concept to be investigated and directly assessed, given a body of testing occurred during 2004 in the FAATC gNFS with bromotrifluoropropene where combustion enhancement was observed. Given the favorable implications offered by these circumstances, the US Army and the FAA Fire Safety Branch agreed to perform an initial investigation of this blend with real-scale testing that occurred during August 2018 in the FAATC gNFS. The August 2018 testing and its basis are the subjects of this presentation. A "small" collection of 18 varied tests were performed. It was noted that the dispersion of the blend was challenging during this testing, as the gNFS test section retained a measurable post-test residue. This observation indicated the sodium bicarbonate did not remain completely suspended in the ventilation stream, thus not transported to the included spray-fire threat. Regretfully, the fraction of sodium bicarbonate remaining suspended was not determined. Regardless, of these 18 tests, [a] all fires in the FAATC gNFS extinguished, [b] pure 2-BTP's behavior in 2018 appeared similar to that observed in 2004, [c] the inclusion of sodium bicarbonate appeared to improve 2-BTP's behavior, & [d] in some instances, the blend somewhat compared to the performance of halon 1301 in this same test environment.