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PROGRAM EXECUTIVE OFFICER
AIR ASW ASSAULT AND SPECIAL MISSION PROGRAMS
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PATUXENT RIVER, MD 20670-1547

IN REPLY REFER TO

Ser PMA-275/V22/357
JUL 21 2008

From: PMA-275 Program Manager
To: Headquarters, Marine Corps,
Department of Aviation, Aviation Logistics Support Branch
3000 Marine Corps, Pentagon Rm 5E518
Washington DC 20350-3000

Subj: RISK OF FIRE FROM V-22 EXHAUST

Ref: (a) Bell Boeing Test Report 901-993-356, Appendix E
(b) NAVAIR Safety Action Record (SAR) 22-02, Grass Fire Due to hot Exhaust

Encl: (1) Excerpt from A1-V22AB-NFM-000 MV-22B NATOPS Flight Manual
(2) U.S. Air Force JOPREP JIFFY report DTG 302000Z MAY 2007
(3) Excerpt from NSWCCD-65-TR-2006/12 March 2006, Structural Evaluation of an LHD-Class Amphibious Ship Flight Deck
Subjected to Exhaust Gas Heat from a MV-22 Osprey Aircraft
(4) Excerpt from National Institute for Standards and Technology (NIST) Technical Note 1481, Ignition of Cellulosic Fuels by Heated and Radiative Surfaces, March 2007

1. To support the transition of the MV-22B Osprey aircraft to the west coast, the program office has been requested to provide information concerning the risk of a grass fire due to the exhaust temperature of the V-22. This letter summarizes the V-22 program office's assessment of that risk.

2. The tiltrotor configuration of the V-22 necessitates that the engine exhaust be directed down with the nacelles in the vertical position. This places the engine exhaust exit 4ft 4in above the ground. To reduce heating of the ground and aircraft components, the V-22 incorporates an exhaust deflector system which directs the exhaust gasses outward, away from the aircraft and the ground. The exhaust deflector system is activated at low power settings with Weight on Wheels, but can be de-selected by the pilot. A temperature profile of V-22 exhaust with the coanda system off is illustrated in enclosure (1). With exhaust deflectors off, the V-22 exhaust temperature at the exit plane is 515 deg F above the ambient temperature decreasing to 150 deg F above ambient temperature at a distance of 4ft 4in below the bottom of the nacelle IR suppressor.

3. To date, there has been one documented grass fire attributed to V-22 exhaust. The fire occurred approximately 10 miles southwest of Troy, Alabama. Enclosure (2) contains the U.S. Air Force JOPREP JIFFY report, similar to a U.S. Marine Corps flash report, detailing the incident. The probable cause of the fire was attributed to an interruption of the exhaust deflector operation. With the exhaust deflector inoperative, the exhaust was directed straight down, increasing the temperature directly below the nacelle to a temperature high enough to support combustion of grass.

4. Testing to measure the effectiveness of the coanda exhaust deflection was performed in 1997. The maximum ground temperature achieved during this testing was 422 deg F (reference a). To quantify the flight deck heating characteristics of V-22 exhaust, with the exhaust defection system operating, testing was conducted aboard USS Wasp in 2005. An instrumented flight deck was constructed to measure deck temperatures for a V-22 with exhaust deflectors operating, at varied engine power settings. A graph of flight deck temperature (in deg F) versus time is presented in enclosure (3). These results show that the flight deck temperature reached 300 deg F approximately 10 minutes after engine start, attained a maximum temperature of 380 deg F 30 minutes after engine start, and remained at 380 deg F for as long as 90 minutes after engine start.

5. Information concerning the combustion temperatures of various plant based materials may be found in NIST Technical Note 1481, Ignition of Cellulosic Fuels by Heated and Radiative Surfaces. This testing was conducted to characterize the ignition behavior of typical outdoor fuels by heated mufflers and catalytic converters found on outdoor power equipment. The fuels tested included shredded newsprint, tall fescue, cheat grass, fine Florida grass, and pine needles. A summary of the test results is presented in enclosure (4), showing time to glowing ignition (in seconds) versus temperature (in deg C) for both no wind and high wind conditions. The figures show glowing ignition is reached at temperatures as low as 572 deg F (300 deg C). This is 150 to 192 deg F above the maximum ground temperatures achieved with exhaust deflectors operating during the 1997 coanda and the 2005 USS Wasp flight deck heating tests.

6. The Naval Air Systems Command (NAVAIR) system safety has also conducted a safety assessment of the risk of a grass fire caused by hot exhaust (reference b). This safety assessment took into account all the information presented above as well as extenuating circumstances such as rigid vegetation extending higher into the exhaust stream and leaking fuel or hydraulic fluid after an extended period with the engines shut down. After taking all of the data and possible circumstances into account, NAVAIR system safety assessed the risk of a grass fire as a remote frequency (> 1 event per million flight hours).

7. The available data indicates, under normal operations, with exhaust deflectors operating, the exhaust of the V-22 should not heat ground to a temperature high enough to support combustion of plant based materials. This conclusion is also consistent with V-22 operational experience. After 44,000 V-22 flight hours and operations to numerous unprepared landing zones at bases and ranges including sites in Alabama, Arizona, California, Florida, Maryland, Nevada, New Mexico, North Carolina, and Virginia, there has been one documented fire with exhaust deflectors inoperative and no documented fires with exhaust deflectors operating.

8. Based on the information available, it is the assessment of PMA-275, that operations to unprepared surfaces can be safely accomplished provided exhaust deflectors are operable. Additional operational mitigations such as avoiding placing rigid vegetation such as bushes and brush directly beneath the nacelle and limiting time the aircraft is on deck in unprepared landing zones will further mitigate this already remote risk.

M.D. MULHERN
COL USMC

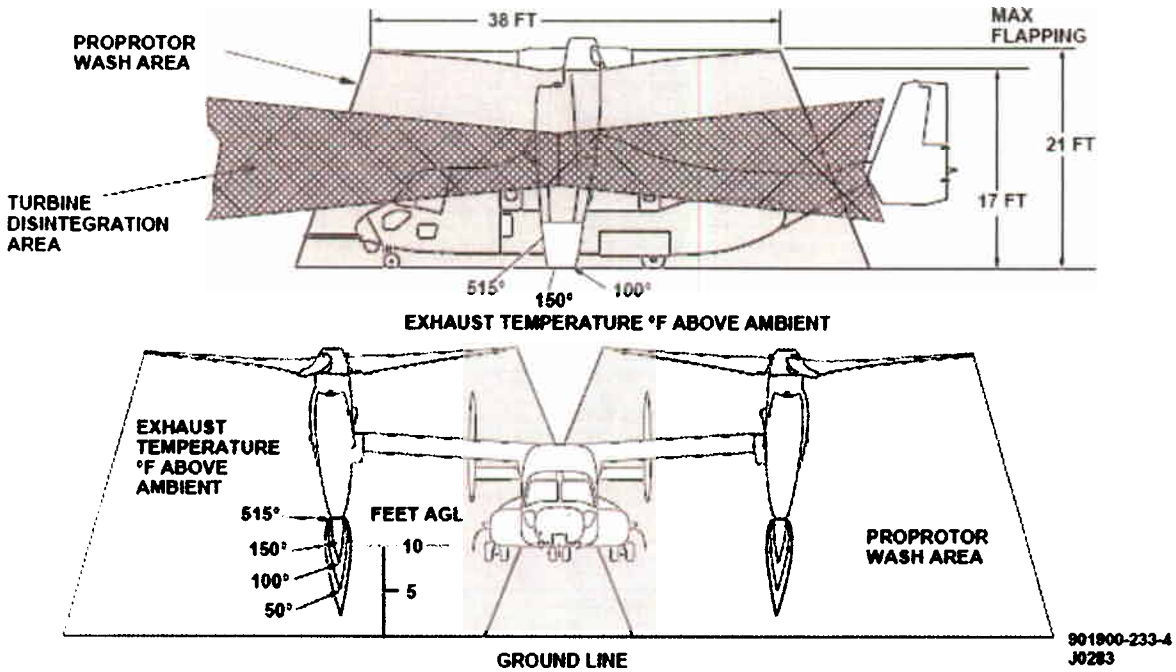

Figure 3-13. Danger Areas
A1-V22AB-NFM-000
NATOPS Flight Manual Navy Model MV-22B Tiltrotor, 1 October 2006

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DTG: 302000Z MAY 2007

FM 1 SOW HURLBURT FIELD FL//CP//

UNCLAS JOPREP JIFFY

MSGID/OPREP-3H/1 SOW/052/MAY//
REF/A/DESC: INITIAL VOICE OPREP-3H REPORT/1 SOW/301951ZMAY2007/052//
FLAGWORD/HOMELINE/-// TIMELOC/300305ZMAY2007/TROY, AL/FINAL//
GENTEXT/INCIDENT IDENTIFICATION AND DETAILS/THE COMMAND POST WAS NOTIFIED AT 300646Z MAY 2007 AND THE COMMANDER APPROVED THE VOICE REPORT AT 301932Z MAY 2007. THE INFORMATION WAS VERIFIED BY THE 8TH SPECIAL OPERATIONS SQUADRON AT 300646Z MAY 2007. A CV-22B, CALL SIGN RAVEN 47, TAIL NUMBER 04-0029 WAS ON A TRAINING MISSION AT A LANDING ZONE (RT392, N31.49.584/W086.10.996) 10NM SOUTHWEST OF TROY, ALABAMA. AT 300305Z MAY 2007, A GRASS FIRE ERRUPTED UNDER THE RIGHT ENGINE EXHAUST SUPRESSOR; THE PROBABLE CAUSE OF THE FIRE WAS DUE TO A MISSION COMPUTER FAILURE INTERRUPTING THE ENGINE EXHAUST DEFLECTOR SYSTEM. THE AIRCREW IMMEDIATELY TOOK OFF AND DETERMINED THAT THE FIRE WAS ONLY ON THE GROUND. RAVEN 47 COORDINATED A WITH LOCAL AIRSPACE CONTROLLING AGENCY FOR A FIRE RESPONSE CREW. ONCE THE FIREFIGHTERS WERE ON SCENE, THE AIRCRAFT RETURNED TO HOME STATION AT 300435Z MAY 2007. RULE 8.8 APPLIES. NO FURTHER INFORMATION AVAILABLE. THIS IS A COMMAND POST FINAL REPORT.//

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Encl (2)

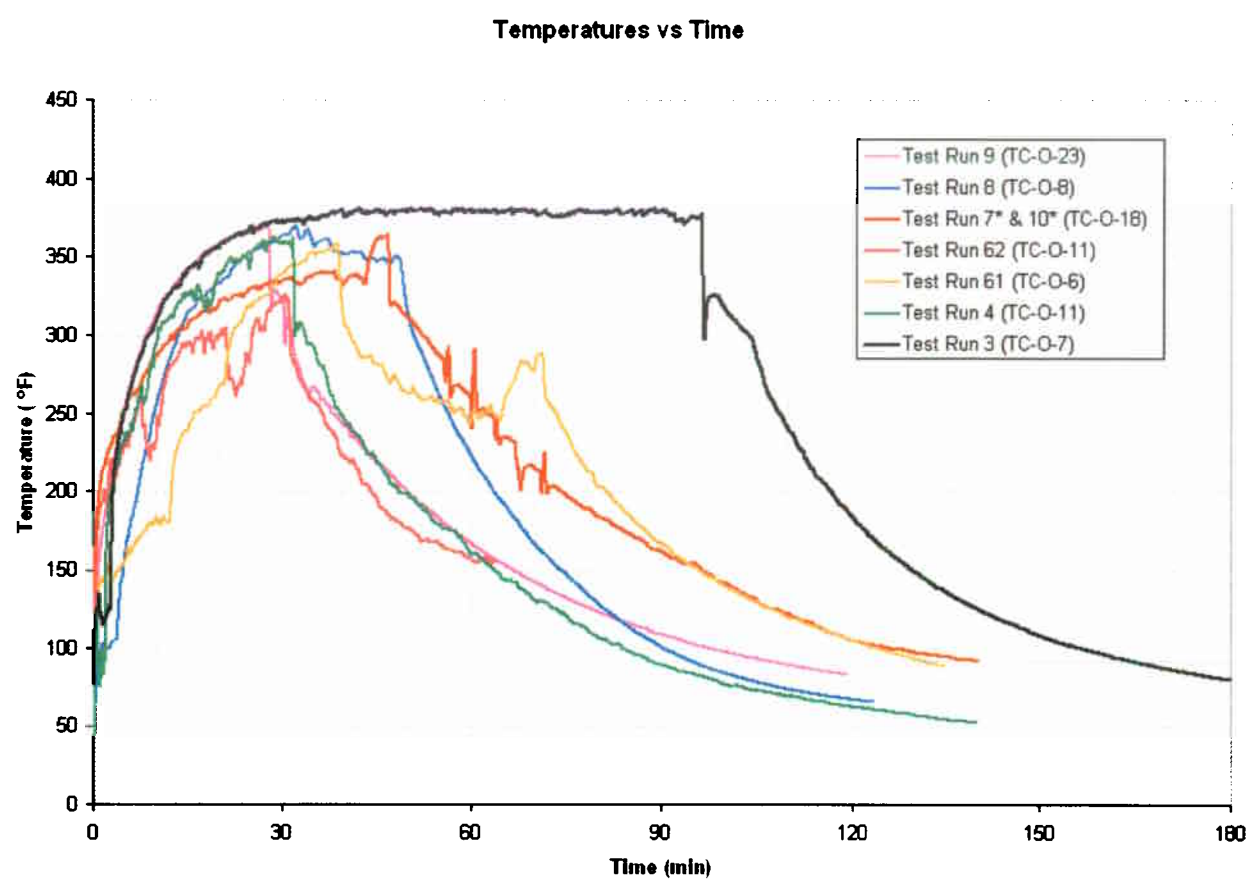

Figure 11. Measured Maximum Temperatures vs. Time (All Tests)

NSWCCD-65-TR-2006/12 March 2006

Structural Evaluation of an LHD-Class Amphibious Ship Flight Deck Subjected to Exhaust Gas Heat from a MV-22 Osprey Aircraft

Encl (3)

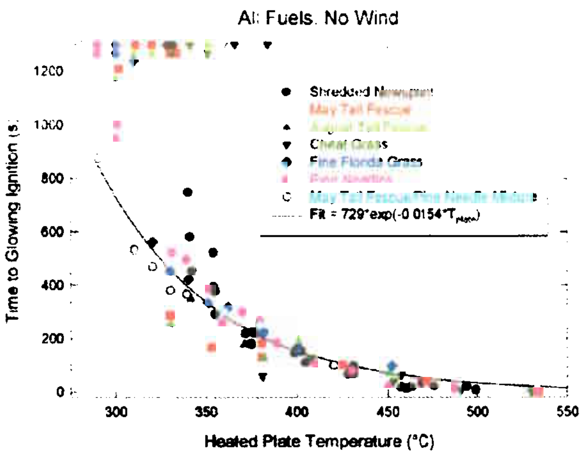

Figure 73. Data for time to glowing ignition with no applied wind are plotted as a function of heated plate temperature for seven fuels. Data near the upper temperature axis represent experiments for which ignition did not take place. The solid curve is the result of a least squares fit assuming an exponential dependence on heated plate temperature for all data where ignition was observed.

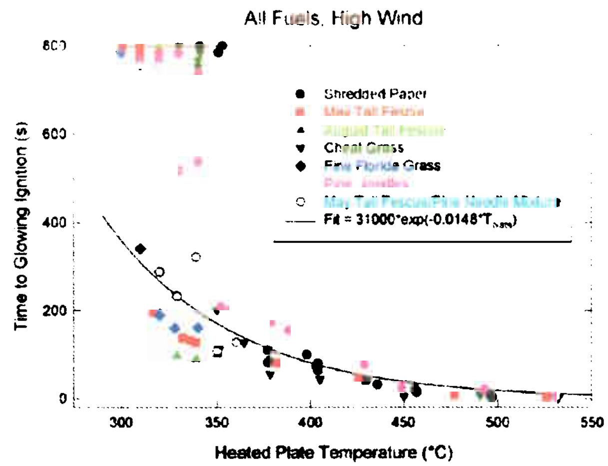

Figure 75. Data for time to glowing ignition with a high applied wind are plotted as a function of heated plate temperature for seven fuels. Data near the upper temperature axis represent experiments for which ignition did not take place. The solid curve is the result of a least squares fit assuming an exponential dependence on heated plate temperature for all data where ignition was observed.

Encl (4)