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File Code: 6700 **Date:** January 18, 2008

Route Thru: R3 Serious Accident Investigation Team, Faye L. Krueger, Deputy Regional Forester; Southwestern Region

Subject: Review of the Wilson Wildland Fire Use Vehicle Loss

To: Deputy Chiefs, Regional Foresters, Station Directors concerned with accident or action plan

References:

(a) 7E72H46 – Accident Investigation Guide 2005
(b) USDA Forest Service Specification for FUSEE, BACKFIRING, 5100-36OE, February 1997
(c) 49 CFR Transportation, Parts 100 to 185
(d) 29 CFR 1901.106 Flammable and Combustible Liquids
(e) Serious Accident Investigation Factual Report Wilson Wildland Fire Use Vehicle Loss June 10, 2006
(f) Wilson Wildland Fire Use Vehicle Loss REPORTS June 10, 2006
(g) 29 CFR 1910 Occupational Safety and Health Standards
(h) NFPA 30 Flammable and Combustible Liquids Handbook
(i) NFPA 1906 Standards for Wildland Fire Apparatus

Per reference (a), the subject review of the Wilson Wildland Fire Use Vehicle Loss was conducted by Alejandro S. Perez, Safety and Occupational Health Manager, Southwestern Region, Albuquerque, NM. The review was conducted of all available records and inspection/analysis of two similar Wildland Fire use Vehicles.

Executive Summary

This review of the Wilson Wildland Fire Use Vehicle Loss (WFUVL) Report was to determine if any additional findings and or recommendations would be in order. This review uses excerpts from Serious Accident Investigation Teams' (SAIT) the Serious Accident Investigation Factual Report Wilson Wildland Fire Use Vehicle Loss June 10, 2006 and the Wilson Wildland Fire use Vehicle Loss REPORTS of June 10, 2006 and other documents references (a) to (i). This independent review is not to dispel other theories, findings or conclusions but it is intended only to provide additional conclusions.

Background

The vehicle fire occurred on June 10, 2006, 1706 hours, at the Wilson Wildland Fire Use (WFU), Gila National Forest, two crew members from the Zion National park Fire Use Module Crew

were conducting weather observations and fire behavior on FS Road 49. The crew truck they used was a 2002 Ford F-450 Super Duty with an S&S Fire Rescue Support package. Fire behavior at the time the crew drove the truck to be parked in the burn location (last parked location) was moderate with flanking fire along FS Road 49 and residual smoke heaviest at the fire flanks. An hour later the fire behavior noted by the two crew member's at the parked vehicle included light residual smoke, no active fire behavior other than minimal stumps burning, light upslope winds with changing direction due to the canyon topography effects. Two and a half hours later the vehicle fire was reported by a Reserve Ranger District employee delivering supplies to the fire crew. There were no injuries associated with the vehicle fire. The crew truck was a total loss.

Findings

For the purpose of this review, only some excerpts from the finding have been used to support conclusions.

Finding 24: (Material)

RECORDS TAB O: Vehicle Inventory (2006) 2002 Ford F-450 Crew Carrier (LN# 1271272): **Compartment 4:** Ammo Can With Three (3) Grenades, Ammo Can with Tow Chain, Ammo Can With Jumper Cables, Ammo Can With Fusees, Ammo Can with Coin (sp) launcher and flares. Hydraulic Jack, Tow Hitch, Bladder Bags (3), Laundry Detergent. (Records TAB O) from reference (e).

Cause

The root cause is a deficiency that the correction, elimination, or avoidance of would likely have prevented or mitigated the accident.

Contributing Factors

A contributing factor is any behavior, omission, or deficiencies that sets the stage for an accident, or increases the severity of injuries or extent of property damage. Contributing factors may be present during an accident but may not have prevented or mitigated the accident if they had not been present.

There are three principle types of evidence: human, material, and environmental. Encompassing these three principles the Review of the Wilson Wildland Fire Use Vehicle Loss selected three probable factors contributing to the fire that consumed the National Park Service crew truck on June 10, 2006. These are: 1) Auto ignition from defective Fusees and 2) Ignition from electrical wiring installed through Compartments 3 and 4 containing flammable, combustible liquids/solids and flammable gas.

Based on the findings, each of the seven probable factors was given a "probability rating". The probability ratings are low, medium, and high.

<u>Probable Factor 1</u>: Auto Ignition due to defective Fusees. High

The Standard Fusee Corporation Material Safety Data Sheet (MSDS) # 0105 of January 1997, provided to the SAIT on August 4, 2006 indicated the Fusee ingredient component and chemical percentage make up of each individual component as listed below. (Record Tab 1)

- The MSDS faxed to the SAIT on 08/04/2006 for the FUSEE was revised on January 1997; Section II – Hazardous Ingredients of the MSDS reflects the following chemical constituents and component percentages.
    - Strontium Nitrate, ± 75%, CAS 10042-769
    - Potassium Perchlorate, ≤ 10%, CAS 7778-74-7
    - Sulfur ≤ 10% CAS 7704-34-9
    - Sawdust/Oil Binder Mixture ≤ 10% CAS None

The revised on-line MSDS for the FUSEE from August 2006, Section II does not reflect the percentage of each chemical constituent for the Fusees. See MSDS Section II below. (Record Tab 1-1)

The MSDS for the Fusee and the Fire Quick Flares are both classified as Flammable Solids, UN 0373 and UN3178, 4.1, DOT Classification per reference (c). Both contain the chemical constituents' potassium perchlorate, which indicated as non compatible storage with and may react explosively with hydrocarbons fuel (gasoline, oil, and oxidizers. The Quoin, Coin, Fire Quick Flares main constituent is Aluminum Powder, which is very explosive.

<u>Finding (Material)</u>

The USDA Forest Service Specification for FUSEE, BACKFIRING, 5100-36OE, February 1997. This publication covers the requirements for one size and type of hand held waterproof fusee. (Records Tab 2)

Paragraph 3.2.4, Fuel Fusee Composition. Fusees containing <u>sulfur shall</u> containing no more than 2.6% potassium perchlorate or an equivalent amount of any other perchlorate. Devices containing a chlorate shall not contain ammonium salts.

Discussion:

The MSDS #0105 for the Fusee/Flares indicates The Fusee contained ≤ 10% potassium perchlorate. This would indicate that the potential for the material to contain a greater amount than the maximum allowed 2.6%, of potassium perchlorate could be anywhere form ≥ 2.7% to the indicated ≤ 10%, thus exceeding the component maximum allowance per reference (b).

Action items

1. MTDC or other profession organization should be tasked to perform periodic testing of Fusee/Flares to determine the Fusee meet the fuel composition percentage requirements per 5100-36OE, 3.2.4 (reference b) and further testing performed to determine if spontaneous ignition could occur at the ≤ temperatures when tested in accordance with 4.5.6.
2. All Fire Use Vehicles transporting Fusee/Flares and Fusees Storage Facilities should inspect Fusees for degradation due to movement, old Fusees lot expiration dates in the compartment and physical condition of shipping containers.
3. Conduct further investigation to determine if any Fusees issued with the same components percentages are still on hand that were issued with the same MSDS number 0105 of January 1997. If any are found, random Fusees should be submitted for testing per item 1.

Probable Factor 2: Ignition from electrical wiring installed through Compartments 3 and 4 containing flammable/combustible liquids/solids and flammable gas. High

Ignition due to source of ignition (electrical wiring to the rear breaks, turn and stop lights signal clusters) through compartments three and four of the 2002 Ford F-450 Crew Carrier (LN# 1271272) containing Class II, combustible liquids, propane canisters and Class 4.1, Flammable Solids.

Finding 04: (Material)

June 08, 2006, at 1730, the crew arrived in Alpine, Arizona. While in Alpine, Crew Member A "rigged" wiring for the air conditioning unit using electrical tape. (Records Tabs D & G) from reference (e).

Finding 05: (Material)

June 09, 2006, at Reserve, New Mexico, the Zion Fire Use Module crew left their hotel at 0645. The instrument panel lights, the rear running lights, and the air conditioning were still not working on the crew truck. (Records Tabs D & G) from reference (e).

Finding 24: (Material)

Records Tab O: Vehicle inventory. **Storage Compartment 3**, contents; **Top Shelf** - indicated Bar Oil (2 – 1 gal. jugs), Bar Oil containers are containers designed with two separate liquid compartments. One side contains (1.5 gal/5 liters) of gasoline and the other side contains 2

quarts/1.8 liters) of oil for mixing with gasoline, 2-Cycle mix, Propane canisters (6), power steering fluid, Antifreeze (1 gal.) and motor oil (1 gal.). **Middle Shelf** – Sigg Bottle Flight Bags, Funnel, Measuring Cup, Hand Sanitizer, Hand Cleaner. **Bottom Shelf** – Drip Torches (4), Dolmars (2), Sigg Bottles (4) from reference (e).

Finding 27: (Material)

June 13, 2006, SAIT looked at a comparable National Park Service Vehicle, a Super Duty Ford F-450 with an S&S Fire Support package. In the compartment where the fusees, Quoin launcher, and grenades were kept the SAIT also found oily rags and motor oil. (See RECORDS Tab O photos of S&S Fire Support package- compartment labeled #4).On the other side of the truck in another compartment (#3), the SAIT found the fuels storage. There was evidence of fuel leakage in this compartment. The "pig" mat was soaked with fuel. In addition the SAIT found that this truck was leaking brake fluid onto the pavement from one of the right sided wheel wells from reference (e).

Finding 40: (Material)

According to a local Tucson, Arizona vehicle mechanic (SAIT phone conversation August 14, 2006) a short in a wire even with low amps could cause a fire. This is also true even if the vehicle were shut off. Electrical current runs to different parts of the vehicle even when the vehicle's engine is shut off. For example with the engine shut off a person can step on the brake pedal and the rear brake lights will light. If the battery is totally isolated/disconnected from the shorted wires, the possibility of a fire is impossible because there is no current to heat up the wires.

Discussion:

Per reference (c), (d), (g) and (h), the storage, handling and use of flammable and combustible liquids and solids require extreme care in order as to not create an environment that can produce an explosive reaction form the leakage of flammable liquids within a compartment in which flammable vapors may be present and or leaking of liquid propane (forms an explosive mixture with air ERG Guide115) due to a release from a safety valve or pressure release valve when heated or if the bottles are overfilled.

Crew members might have compromised the integrity/requirements of the wiring harness per NFPA 1906, Chapter 6, 6.2 by performing "rigged wiring" on the Super Duty crew truck on by performing on the way repairs per Findings 04, 37, 38, 39 and 40. The SAIT indicated that the vehicle had electrical problems at least a week before departure on the assignment as electrical current is always on system as the lights on the rear signal, turn, and break lights cluster.

Inspections of two separate (See WLFU Similar Vehicle Photos) Wildland use Super Duty Ford F-450 with an S&S Fire Support package findings indicated;

1. Unprotected wiring and unprotected wiring thru holes in compartments 3 and 4. Explosive flammable vapors may travel to source of ignition. Photo A & G.
2. Rags/Towels soaked with flammable liquids. Photo B & D.

3. Flammable liquid soaked PIG pad, leakage of fuel between mud flag and storage compartment due to missing rubber gasket and vehicle body. Photo(s) F, F-1 & F-2.

Action items

1. In the interim all holes through compartments leading to turn, signal light clusters should be sealed with non electrical conductivity sealer.
2. Future installation of S&S Fire Support package should not be wired through storage compartments. Recommend to package manufacturer modification of the S&S Fire Support package.
3. Before, during and after deployment, ensure that all fuel spillage is cleaned up.
4. All Dolmars, SIG Bottles or other fuel containers should be stored in the upright position to prevent spillage and reduce the probability of fuel vapors in vehicle storage compartments.

Please take recommended action to address those items noted. While some of the standards noted may be more applicable to General Industry, it is in the best interest of best "safety practices". Keeping in mind that federal regulations are "minimal requirements", and to apply more stringent or alternate standards per 29 CFR 1910.16 & .17.

Federal regulations require a copy of the review be maintained on file for 5 years at the home facility. A copy should also be provided to the local safety officer, safety and health committee, and employee representatives.

If you have any questions about this review, please contact Mr. Alejandro S. Perez, Southwestern Region, Safety and Occupational Health Manager, at (505) 842-3133.

/s/ Faye l. Krueger for
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cc: Directors (responsible for action items, MTDC