Redwood Engine 30 Vehicle Fire

Non-Serious Accident Investigation

Lessons Learned Review

Redwood Engine 30 after the vehicle fire incident.

Contents

1. Introduction

On June 27, 2011, at approximately 1030 hours, a Redwood National and State Parks Type 6 Wildland Fire Engine—Redwood Engine #30, a 2008 Ford F-550 was returning from a severity assignment when the engine made a noisy thud and began handling rough.

The passenger noticed driveline parts flying out behind the vehicle—that started a wildfire. The driver pulled the engine into the median and quickly exited the vehicle—detecting that it was on fire.

The passenger called 911 and began tossing fuel cans and equipment off the truck while the driver attacked the vehicle fire with the fire extinguisher until it was fully discharged and then began setting up traffic control and waited for the local rural fire department's response.

The fire destroyed the vehicle where it was located there on the westbound lane median of Interstate 10 (I-10) at Milepost 107, outside Buckeye, Ariz., approximately 30 miles west of Phoenix.

The Redwood Engine 30 fire occurred on Interstate 10 at Buckeye, Ariz.—approximately 30 miles west of Phoenix.

A. Investigation Process

The purpose of the Non-Serious Accident Investigation (NSAI) is to:

1. Identify facts of the events and develop a chronological narrative of the event;
2. Identify what was learned and what should/or could be done differently in the future;
3. Identify any recommendations, as provided by the field personnel and safety officer, that would prevent or mitigate similar occurrences.

The purpose of the Lessons Learned Review (LLR) is to:

1. Gather the facts of the events to develop a chronological narrative of the event;
2. Identify underlying reasons for success or unintended outcomes;
3. Identify what was learned and what should/or could be done the same or differently in the future to prevent or mitigate similar occurrences in the future.

The National Park Service (NPS) Regional Directorate recommended the Park Superintendant complete a Non-Serious Accident Investigation to be forwarded to the NPS Wildland Fire Safety Program Manager and Regional Fire Management personnel. Subsequently, the Division Chief/Designated Agency Health and Safety Official, Fire and Aviation Management delegated the Deputy Regional Fire Management Officer the authority to conduct a Lessons Learned Review and combine with NSAI to strengthen and provide a learning opportunity.

B. Background

The Redwood Engine 30 was a National Wildfire Coordinating Group (NWCG) Type 6 Engine. The chassis was a Ford F-550 Super Cab (162" wheelbase), dual-rear-wheels four-wheel drive. It was ordered from S & S Fire Apparatus in Fairmont, Indiana on Sept. 26, 2007 by the NPS Fire Management Program Center (FMPC). The vehicle was accepted on March 27, 2008. The Redwood Engine is not part of the Working Capital Fund (WCF) and therefore was not purchased through the WCF interagency agreement.

Prior to Fiscal Year 2011, the NPS purchased non-WCF vehicles on a separate NPS national contract when funding was available. The vehicle configuration was the standard S & S Fire Apparatus with a complement of typical options. S & S Fire Apparatus was a General Service Administration (GSA) contractor until going out of business in 2008.

Engine 30 Sent to Severity Assignment in Saguaro National Park

Redwood Engine 30 was requested to fill an order for a Type 6 Engine Module (three persons) on a severity assignment in the Intermountain Region—specifically, to report to Saguaro National Park.

The crew mobilized on June 11, 2011, and arrived to their reporting location the following day. Although the Southwest Geographic Area was in Preparedness Level 4 & 5 for numerous weeks, the engine module had no wildfire responses other than a short one-day assignment which involved driving to the Coronado National Monument.

The module worked 11-hour shifts for 14 days until June 27, when they demobilized to their home unit. At the time of the incident, the engine was in route to their home unit after a fuel stop and break at a gas station in Buckeye, Ariz.

2. Chronology of Events

Monday June 27, 2011

0630

Employees on duty and begin travel, driving approximately 135 miles.

1000

Two employees stop to refuel the vehicle and take a break at the gas station in Buckeye near the Jack Rabbit Trail off-ramp. The third employee is riding with another employee, returning later that same day.

1030

The employees continue driving down Interstate I-10.

Employee #1 is driving when Employee #2 hears/feels a thump and notices that the truck is handling rough. As Employee #1 steers the engine into the center median—away from traffic—Employee #2 looks into the side mirror and notices drive train parts shooting across the roadway from the engine. Employee #2 also notices the universal joint shoot across the lanes of traffic. At this time, the engine comes to rest in the center median.

Employee #2 notices that a wildland fire has ignited on the north side of the Interstate. As Employee #2 exits the truck, he grabs one of two cell phones that he carries.

Employee #2 notices a small fire has ignited under the vehicle near the transmission. After looking to see if Employee #1 has exited the vehicle safely, Employee #2 calls 911 to report both the vehicle fire and wildland fire.

At this point, Employee #2 notices that the fire extinguisher on the vehicle is safe to reach. He gets the extinguisher and hands it to Employee #1, who attempts to extinguish the fire.

This effort provides Employee #2 the time to remove some fuel containers, safety equipment, and other line bags from the truck. After the extinguisher is fully discharged, Employee #1 sets up the traffic reflectors to warn oncoming traffic.

Employee #2 reaches in to remove another cell phone and binder, realizing that the cab is too engulfed to remove anything else.

1115

An Arizona State Police Officer arrives and blocks all traffic on westbound I-10 due to smoke crossing the roadway.

1120

Buckeye Rural Fire arrives and starts fire control operations on both fires. Arizona Department of Public Safety Officer also arrives.

1135

Both fires are extinguished.

1227

Tow truck arrives and tows the engine to a towing yard in Buckeye, Ariz.

The Next Day

Tuesday June 28, 2011

Authorization is given to the towing company to transport the burned vehicle from the towing yard to Goldenfield Fire Center on the Tonto National Forest east of Mesa, Ariz.

July 22, 2011

The Ford Motor Company contacts the National Park Service requesting information regarding the Redwood Engine.

July 25, 2011

The National Park Service replies affirmatively, supplying the requested documentation. The NPS expressed interest in proceeding collaboratively in determining cause in order to foster firefighter safety.

August 17, 2011

Ford completes a physical examination of the vehicle. At the time this report is finalized and released, Ford has not yet informed the National Park Service of its findings.

Burn Scorch Area *– The Interstate 10 median space where Redwood Engine 30 burned.*

3. Factors Considered

A. Human Factors

- Fatigue: Employees left Redwood National and State Parks in Crescent City, Calif. on June 11, 2011 enroute to Saguaro National Park. They arrive at Saguaro National Park the next day. Employees work 11-hour days for 14 days with 13 hours of rest prior to their demobilization. On June 27, employees start work at 0630 hours to drive back to Redwood National and State Parks in Crescent City, Calif.
- Employee was driving at approximately 70 mph.

B. Material Factors

- Employee verified that when they stopped to refuel, no diesel was spilled onto the vehicle. In addition, the fuel cap was secured tightly.
- Gross Vehicle Weight Rating (GVWR) for this 2008 F-550 was 19,500 pounds. Vehicle weight at time of incident was 15,600 pounds. This weight included vehicle, equipment, water, and fuel. This weight did not include crew or gear. The vehicle has six seated positions.
- This vehicle had been serviced on May 16, 2011 to include: oil change, lubrication, hydraulic fluids check, replacement of air filters, and visual inspection underneath the vehicle to check all components.
- No fluids were observed on the ground where the vehicle had been parking during the 14 days at Saguaro National Park.
- The vehicle's automatic transmission was in the "D" drive position.
- No previous mechanical failures were known for this vehicle.
- The Ford Motor Company was contacted to verify no recalls for this vehicle at this time.
- After loud noise was heard, vehicle began to drive rough with mechanical parts falling to roadway from underneath vehicle.
- Drive train parts (specifically the transfer case) were found on roadway with no burn/charred marks.
- The left front hub was found in locked position.
- The right front hub was damaged in the fire. Therefore, its position could not be visually determined.
- The transfer case was fully destroyed/disintegrated.

- All of cab—including wiring and electrical—was completely destroyed by fire.
- Front right tire was destroyed. All other tires remain intact (although the right rear outside dual was off the rim).
- Exhaust system—including Diesel Particulate Filter—remains intact with little damage.
- First section of the rear drive shaft is entirely split and spread wide open.
- Rubber components of the idler bearing on the rear drive shaft are melted.
- Components to the rear of the transfer case appear to have suffered far less fire damage than the front and right half of the vehicle.
- Four-wheel drive was not utilized while the vehicle was on assignment.

Drive train parts found on the roadway.

C. Environmental Factors

- The day of the vehicle fire—July 27, 2011—was a clear, dry, and hot day.
- Traffic was light. No other vehicles were within view when the incident occurred.
- Road was clear of any debris.

4. Findings

Human

While employees had been working long days, they were not working the maximum hours and were provided more than the required rest time.

Environmental

No factors found.

Mechanical

Four-wheel drive was not utilized over the course of the incident. However, the left front hub was found in the locked position.

5. Conclusions and Observations

No Definitive Cause
To date, no definitive cause for this incident has been determined.

The National Park Service has been in contact with the Ford Motor Company. Ford sent a representative to inspect the vehicle. However, to date, no information has been shared with the National Park Service.

(In the future, if the National Park Service is able to obtain definitive information on the specific cause regarding the loss of Redwood Engine 30, these findings will be posted with this report on the Wildland Fire Lessons Learned Center Incident Reviews website.)

Good Decisions
The employees involved in this incident made many good decisions before and during the incident. Removing themselves from close proximity to the vehicle fire and immediately taking safe but effective public safety measures by using reflective equipment from the engine is just one example of their proactive actions.

A. Actions, Decisions, and Behavior to Sustain within the National Park Service

1. Crew was rested and off shift 13 hours prior to traveling home. Crew had taken a 30-minute break before incident occurred.
2. Crew members immediately responded to the noise and thump under truck by pulling the truck off into the median away from traffic.
3. Crew immediately dialed 911, initiated action to extinguish vehicle fire with fire extinguisher, evacuated fuel cans, safety equipment, fire gear, and set up traffic control.
4. Crew did not overextend their firefighting capabilities, recognized when fire extinguisher was not effective and adjusted tactics.
5. Crew fully cooperated with jurisdictional law enforcement agency and made appropriate notifications.
6. Engine had been recently weighed. It was under the gross vehicle weight rating (GVWR). Engine was serviced May 16, 2011. A walk around inspection was performed during rest break and fuel stop.
7. The crew of three had purposefully split to add one passenger to a second vehicle returning from Saguaro National Park to Redwood National and State Parks that day—ensuring that both vehicles had two occupants to share driving duties.

Redwood Engine 30 at the Arizona tow yard.

8. Crew member was familiar with the location of fire extinguisher to quickly access and operate.
9. The crew continues to review and drill on emergency procedures and protocols.

B. Potential Areas of Improvement within the National Park Service

1. Ensure daily preventative maintenance checks occur. Include checking manual or combination auto/manual locking hubs to ensure that they are in the proper position.
2. Ensure preventative and maintenance checks are performed regularly and documented.
3. Visually inspect and determine the transfer case and front hub engagement methods.
4. Operation of vehicle should be in accordance with the owner's manual.
5. An understanding of the various types of accident investigations/reviews, their purpose, and who is responsible would streamline information gathering and timeliness of distribution of lessons learned.

6. Investigation/Review Team

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7. Appendices

Appendix A – Four-Wheel Drive Vehicle Basics

The dynamic nature of the fire environment sometimes causes us to operate a vehicle other than the one we are used to, have non-typical drivers operate our vehicles, or operate vehicles in unaccustomed places or ways.

It is important that all vehicle operators know the configuration and understand the operation of the vehicles they are driving, including four-wheel drive operation. There are different configurations of conventional two-wheel drive (including front- and rear-wheel drive) and four-wheel drive (including all-wheel drive) vehicles. Most of the National Park Service's specialized wildland fire fleet consists of four-wheel drive vehicles and some rear two-wheel drives.

With rear two-wheel drive operation, torque from the engine is transmitted (through the transmission) to a rear driveshaft then to the differential and finally through the axles to the rear wheels. On most vehicles, the axle applies the amount of torque based upon the wheel with the least traction. If the vehicle is equipped with a limited slip rear differential, when a single wheel begins to lose traction or slip, more torque is automatically applied to the other wheel. The differential also allows the wheels to spin at different speeds for cornering.

With four-wheel drive operation, more components are added. Specifically, a transfer case, front drive shaft, front differential, front drive axles, and front hubs (automatic and/or manual locking) are introduced into the drive train.

The transfer case is attached after the transmission and before the rear drive shaft. When the transfer case is not engaged, power is transmitted through it and only to the rear drive shaft (similar to the explanation above). When the transfer case is engaged, power is distributed to both the front and rear driveshaft and other components, and finally to each wheel. Unlike the rear wheels, in order for the torque to be applied to the front wheels, the front hubs must also be locked. If the front hubs are not locked and the vehicle is in four-wheel drive, the front driveshaft and front axle turns, but no torque is applied to the front wheels.

The three styles of hubs are Automatic, Manual, and Combination Auto/Manual.

Automatic Locking Hubs

Automatic locking hubs have no dial switch and engage automatically when four-wheel drive is engaged by the transfer case and torque is applied to the front axles.

With automatic locking hubs, the hubs are automatically unlocked/disengaged after the transfer case has been taken out of four-wheel drive. On vehicles equipped with automatic locking hubs, properly shifting the transfer case (at the correct speeds and, possibly, transmission gear position) is typically the only action that needs to be performed to go from

four-wheel drive to two-wheel drive. Some manufactures recommend backing the vehicle to fully disengage the front hubs after the transfer case has been taken out of four-wheel drive.

Manual Locking Hubs

Manual locking hubs have a physical rotating dial switch on the outside of each of the front hubs. In order for torque from the front axle to be applied to the front wheels, each dial switch must be rotated to the "locked" position.

For manual locking hubs, the hubs must be physically changed from "locked" to the "free" position in order for front hubs to be disengaged. This can be done before or after the transfer case has be disengaged from four-wheel drive.

There is never any reason to operate the vehicle with the transfer case of a four-wheel drive engaged and manual locking hubs in the unlocked or "free" position. In addition, there is no reason to ever travel extended distance or time with the four-wheel drive disengaged while front hubs remain in the locked position and four-wheel drive engaged by the transfer case.

Combination Auto/Manual Hubs

Combination Auto/Manual hubs are a hybrid of the two types (automatic and manually locking) where the front hubs have a physical rotating dial switch but the choices are "auto" or "locked".

If the dial switch is in the "auto" position, the hubs perform similar to standard automatic locking hubs and engage when the transfer case is put into four-wheel drive. However, the hubs have the ability to disengage depending on the conditions or by disengaging four-wheel drive in the transfer case. The auto position on the combination hub should be used whenever operating in two-wheel drive, or for travel in poor road conditions (such as snow, ice, mud).

If the dial switch is in the "locked" position, the front hubs are fully locked and will not unlock regardless of the transfer case position. There is never any reason to travel extended distance or time with the four-wheel drive disengaged while front hubs remain in the locked position. The locked position should only be used for self extrication, or to get the vehicle through unexpected severe off-road conditions.

Engaging and Disengaging Four-Wheel Drive

Four-wheel drive is engaged and disengaged one of two ways—using the mechanical shift level on the floor or the electronic switch on the dashboard (depending on the selected options on the vehicle).

When four-wheel drive is disengaged, power from the transmission is not applied to the front drive train components. However, if the front four-wheel drive is disengaged and the front hubs are locked, the front drive train will spin whenever the vehicle is in motion.

Locked Hub

Allowing the front axles and driveshaft to spin unnecessarily decreases fuel efficiency, causes unnecessary wear and tear, effects handling, and decreases performance. This causes unnecessary dangers and can lead to severe damage—and possibly fatal injuries. It is therefore important to follow the manufacturer's recommendation and ensure that front hubs are not locked if four-wheel drive is not engaged.

Typically, the vehicle owner's manual outlines the proper procedures for operating the four-wheel drive system. Following these guidelines will ensure engagement and disengagement of the transfer case as well as the setting of the hubs for the particular vehicle to perform properly.