Fire and Safety Hazards of Recreational Vehicles

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Abstract

8.9 million households, or 8.5% of vehicle owning households in the United States own a recreational vehicle. Additionally, 5% of the U.S. population over the age of six spends some time camping in an RV each year. Based on the current U.S. population of 324.4 million, nearly 16 million people per year spend time living in an RV. These statistics indicate that a sizable portion of the U.S. population may be exposed to a hazardous situation related to living in or transporting a recreational vehicle. The problem is that the Pearland Fire Department has not identified the fire and safety hazards associated with transporting and residing in recreational vehicles. The purpose of this research is to identify the fire and safety hazards associated with transporting and residing in recreational vehicles. A descriptive research methodology was used to answer the following research questions: (a) What transportation related factors create fire and safety hazards in recreational vehicles? (b) What construction related factors create fire and safety hazards in recreational vehicles? (c) What occupant behaviors create fire and safety hazards in recreational vehicles? (d) What fire and safety standards exist for recreational vehicles? A literature review, an analysis of TEXFIRS data, a survey of fire service leadership, as well as a study of industry standards and federal regulations were conducted. The research shows that recreational vehicles share the risks of fire and other hazards with both residential structures and vehicles, though the overall risk is rather low. Future research should be geared specifically towards recreational vehicle safety and creating better methods of capturing data that identifies incidents unique to this type of hybrid of a vehicle and residential structure.

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Fire and Safety Hazards of Recreational Vehicles

Traveling with a recreational vehicle is leisure activity enjoyed by nearly 16 million people in the United States each year. Being a hybrid of a vehicle and a residence, it provides freedom for travelers to travel with the comforts of home, at their own pace, with the ability to cook their own meals, and to travel with pets. Americans who travel on interstate highways are bound to see numerous motorhomes, travel trailers, and other RVs of various shapes and sizes sharing the roadways. Billboards for RV parks and campgrounds are also frequent sights for those who spend time on the road.

A memorable event earlier in my career was a travel trailer fire in an RV park. It was a cold, windy, winter night and dispatch indicated that people were trapped. Upon leaving the station, a smoke column and flames were visible from over a mile away and I remember thinking that if we don't act fast, the entire RV park will be on fire. Upon arrival, the rear half of a travel trailer was fully engulfed in flames, and radiant heat and blowing embers were causing two other RVs to begin to ignite. Our initial fire attack focused on protecting the exposures and cooling the propane tanks of the burning RV. A severely burned older gentleman indicated that he tried to go back in to rescue his wife and dog but was unable to do so. Being the first fatal fire I experienced in my career, I recognized that recreational vehicles had unique challenges for firefighters.

The problem is that the Pearland Fire Department has not identified the fire and safety hazards associated with transporting and residing in recreational vehicles. The purpose of this research is to identify the fire and safety hazards associated with transporting and residing in recreational vehicles. A descriptive research methodology will be used to answer the following research questions: (a) What transportation related factors create fire and safety hazards in

recreational vehicles? (b) What construction related factors create fire and safety hazards in recreational vehicles? (c) What occupant behaviors create fire and safety hazards in recreational vehicles? (d) What fire and safety standards exist for recreational vehicles?

Background and Significance

The background to this problem is related to the following three issues: the high rate of recreational vehicle ownership; the variability in types of vehicles and the hazards they pose; and the lack of fire service training specific to these vehicles. An internet search for RV fires indicates that these events happen on a near daily basis across the United States.

As of 2011, 8.9 million households in the U.S. owned a recreational vehicle. This represents 8.5% of vehicle owning households (Curtin, 2011, p. 1). Additionally, 5% of the U.S. population over the age of six spends some time camping in an RV each year (The Coleman Company, Inc. & The Outdoor Foundation, 2014, p. 4). Based on the current U.S. population of 324.4 million, nearly 16 million people per year spend time living in an RV (http//www.census.gov). These statistics indicate that a sizable portion of the U.S. may be exposed to a hazardous situation related to living in or the transportation of a recreational vehicle.

Recreational vehicles vary from small pop-up camper trailers that can be towed behind a car to large tandem axel motor homes that resemble a commercial tour bus. The cost, complexity, driving dynamics, and hazards associated with these vehicles vary greatly.

The hybrid nature of recreational vehicles has not been adequately addressed through training in the fire service. Recreational vehicles have unique characteristics that differentiate them from other vehicle types, as well as their ability to be rapidly and easily transportable make them different from other occupancy types.

The City of Pearland, Texas is a home rule municipality located in the Houston-Sugar Land-Baytown Metropolitan Statistical Area. About a 20-minute drive from downtown Houston, Pearland is a rapidly growing community of over 139,000 residents living within a 72 square mile area (http://www.pearlandtx.gov). In the year 2000, Pearland had a population of 37,640. By 2013, the population reached 101,900, an increase of over 170%. It is projected that by 2040 the city will gain another 46,000 residents (Pearland Economic Development Corporation, 2013, p. 2).

The community is home to one large RV resort that has sites for 345 vehicles (http://www.advancedrvpark.com). While the majority of fire department responses there are of a medical nature, there have been fire incidents there in the past including a recent fire that resulted in the fatality of a pet. Additionally, there are numerous RV storage facilities in the community as well as RVs that are parked adjacent to private residences. State Highway 288 and State Highway 35 which both lead to coastal areas popular with RV travelers cross through Pearland.

The Pearland Fire Department is a municipal agency that provides fire suppression, rescue, EMS transport, fire investigation, code enforcement, and public education. The department responds to approximately 10,000 requests for service annually. With a current 52 personnel on duty daily, the department is expected to provide an all-hazards response capability.

This research is significant for the following reasons: the growth in RV ownership has increased at a rate of 1.9% per year (Curtin, 2011), Texas is the top destination for new RV shipments, and there is a general lack of research and statistics on RV incidents.

This research links to the Executive Leadership course of the Executive Fire Officer Program in that it better prepares the community for all-hazard incidents by addressing goals two

and three of the United States Fire Administration's Strategic Plan. Goal 2 is to "Promote Response, Local Planning and Preparedness for All Hazards", and Goal 3 is to "Enhance the Fire and Emergency Services' Capability for Response to and Recovery from All Hazards." (United States Fire Administration [USFA], 2014, p. 9).

Fire departments must have current information and training to plan for and respond to all types of hazards that exist in the community. Planning and preparedness are essential functions of any emergency services organization.

Literature Review

According to the Recreational Vehicle Industry Association (RVIA), an RV is a "vehicle designed as temporary living quarters for recreational, camping, travel or season use. RVs may be motorized (motorhomes) or towable (travel trailers, folding camping trailers and truck campers)" ("About RVIA," n.d., para. 2).

RVs come in a variety of configurations, but generally fall into one of two categories: self-propelled and towed. The self-propelled RVs, commonly referred to as motorhomes are further classified as Class A, Class B, or Class C. A Class A motorhome is one in which the chassis and drivetrain are supplied by a chassis manufacturer, while the cab and living space are built by a specialized RV manufacture. These RVs typically resemble a commercial bus. A Class B motorhome is a van conversion. These vehicles utilize the basic packaging of a van but with the cargo area modified as a compact living space. A Class C motorhome is one in which the chassis, drivetrain, cab, and driving controls are supplied by a chassis manufacture, while an RV manufacturer builds the body that contains the living space. These are most typically seen on a cutaway van chassis (Solberg, 2011).

Towable RVs are available in two major configurations; those that are pulled by a frame mounted receiver hitch, known as a travel trailer, and those that are pulled with a fifth-wheel hitch. Fifth-wheel RVs are generally much larger and heavier than travel trailers and need a dedicated pickup truck configured for towing to transport them. Travel trailers can be towed by any vehicle that has sufficient towing capacity, though typically a pickup or SUV are utilized. A sub-class of the travel trailer is the folding camping trailer. This is a small, lightweight trailer where the living space is comprised primarily of a tent-like structure that expands from a low-profile trailer. A final type of RV is the pickup camper. This is a small living space that slides into the bed of a pickup (Solberg, 2011).

There are two primary construction techniques used in RV manufacturing today. The first type uses wood framing for the side walls and roof, loose fill insulation, and aluminum for the exterior skin. The other common construction method utilizes aluminum framing with the exterior walls made of fiberglass bonded to a thin plywood substrate, with block foam insulation. Roofs may be aluminum, fiberglass, or a membrane attached to wood or aluminum framing. Both construction types are built on to a steel chassis or trailer frame (Solberg, 2011).

Common to nearly all RV types are sleeping areas, a cooking area, a toilet, heating and cooling appliances, and fresh water and contaminated water plumbing and storage. Most RVs are designed so they can be used both independent of external utilities or at a facility where external utilities are provided. To facilitate this, RVs typically have propane tanks to run a refrigerator, furnace, water heater and cooking appliances. They also have storage tanks for fresh water, grey water, and waste water. On-board batteries, and in some cases a generator, provide electricity. RV parks often provide external water, sewage, and electricity hookups in order to facilitate longer term living that does not rely solely on resources that must be carried in

the limited storage available in an RV. Most refrigerators, and water heaters are dual mode and operate on electricity when external power is available. The air conditioning system is only capable of operating when external power or sufficient generator power are available (Solberg, 2011).

Academic research about RVs is limited, and of that which has been published, much of it is over 20 years old. Most of this research has been commissioned by the RV industry itself and is focused on the demographics and consumption patterns of RV users (Hardy & Gretzel, 2011). According to Curtin (2011), the typical RV owner is 48 years old, married, and has an average income of $75,000. Approximately 39% have children living at home. A survey by Fjelstul (2013) shows the typical travel party of an RV trip.

Table 1

Typical Travel Party and Mileage Projected per Trip by Age Group

Variable	Age Groups		
	Ages 35-49	Ages 50-64	Ages 65+
Travel Party			
At least 1 other adult, with children	33%	11%	6%
At least 1 other adult, without children	25%	51%	56%
No other adult but with children	2%	1%	1%
Extended family, with children	15%	9%	6%
Extended family, without children	6%	8%	7%
With a group but in separate RVs	15%	14%	17%
Alone	4%	16%	7%
Projected Mileage per Trip			
<50 miles	4%	3%	3%
51-100 miles	10%	6%	6%
101-250 miles	34%	19%	10%
251-500 miles	15%	14%	11%
501-1000 miles	16%	19%	19%
1000+ miles	21%	39%	51%

Note. Adapted from "Exploring pull factor influences at campgrounds by RV association members," by J. Fjelstul, 2013, *Journal of Tourism Insights*, 4(1), p. 7. Copyright 2013 by ScholarWorks@GVSU.

The typical RV is used for an average of 20 days per year (Curtin, 2011, p. 35) and the average camping trip was 186.7 miles from home (The Coleman Company, Inc. & The Outdoor Foundation, 2014, p. 19). A primary reason that people are attracted to RV travel is that an RV is considered an extension of their home and therefore are able to travel with the comforts of home with them. This include items such as bedding preferences, food, and most significantly their pets (Hardy & Gretzel, 2011).

According to the Centers for Disease Control and Prevention (CDC), the health and safety risks associated with manufactured structures have some key differences compared to traditional site-built structures. Due to their transportability, there are many compromises in terms of manufacturing, construction materials, and how the structures are sited and connected to utilities. These health and safety hazards are related to fire safety, moisture and mold, indoor air quality, and pests (Ryan & Bowles, 2011).

In its research, the National Fire Protection Association (NFPA) notes that motorhomes and travel trailers do not fall into the same category as manufactured homes, and therefore it's statistics on fires in manufactured homes cannot be applied to RVs. However, a characteristic shared by RVs and most manufactured structures is that they are smaller than other living unit types. This implies that average room sizes are smaller, which can lead to flashover conditions to develop more rapidly (Hall, 2013).

The U.S. Fire Administration does include RVs in their statistics on fire fatalities in residential buildings. While not outlined specifically, NFIRS incident type 122, "Fire in motor home, camper, recreational vehicle" is included. The following figures show the primary causes of fires that lead to both injuries and fatalities in residential buildings, as well as the age distributions in which they are most common. Smoking is among the most prevalent cause of fire fatalities, while cooking is the most prevalent cause for injuries from fires.

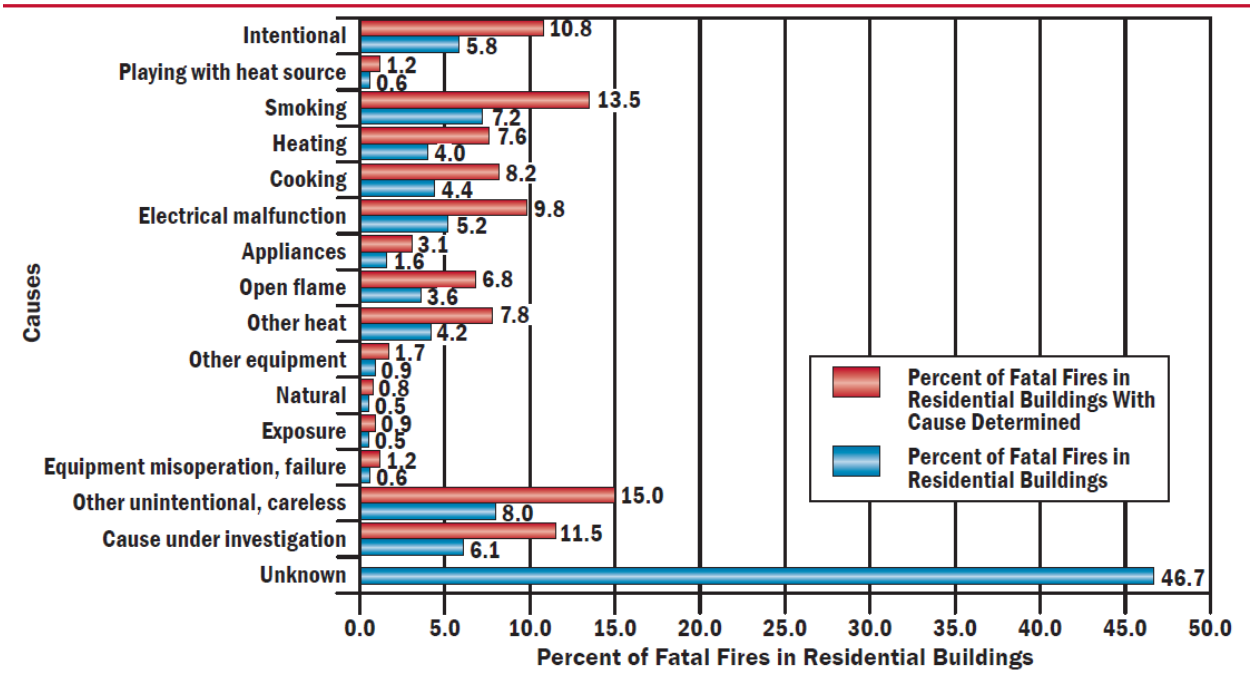

Figure 1. Causes of Fatal Fires in Residential Buildings (2012-2014). Adapted from "Civilian Fire Fatalities in Residential Buildings," by USFA, 2016, p. 5.

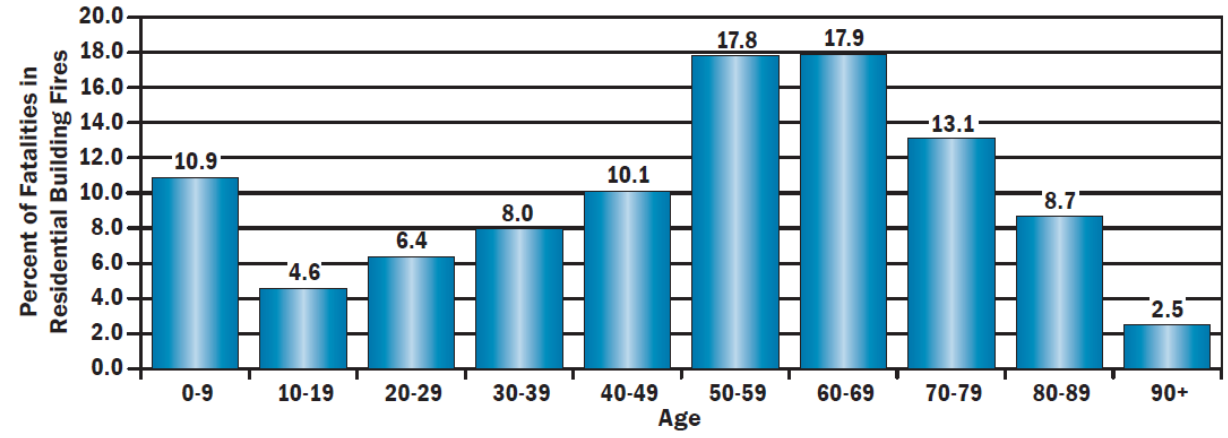

Figure 2. Civilian Fire Fatalities in Residential Buildings by Age Group (2012-2014). Adapted from "Civilian Fire Fatalities in Residential Buildings," by USFA, 2016, p. 6.

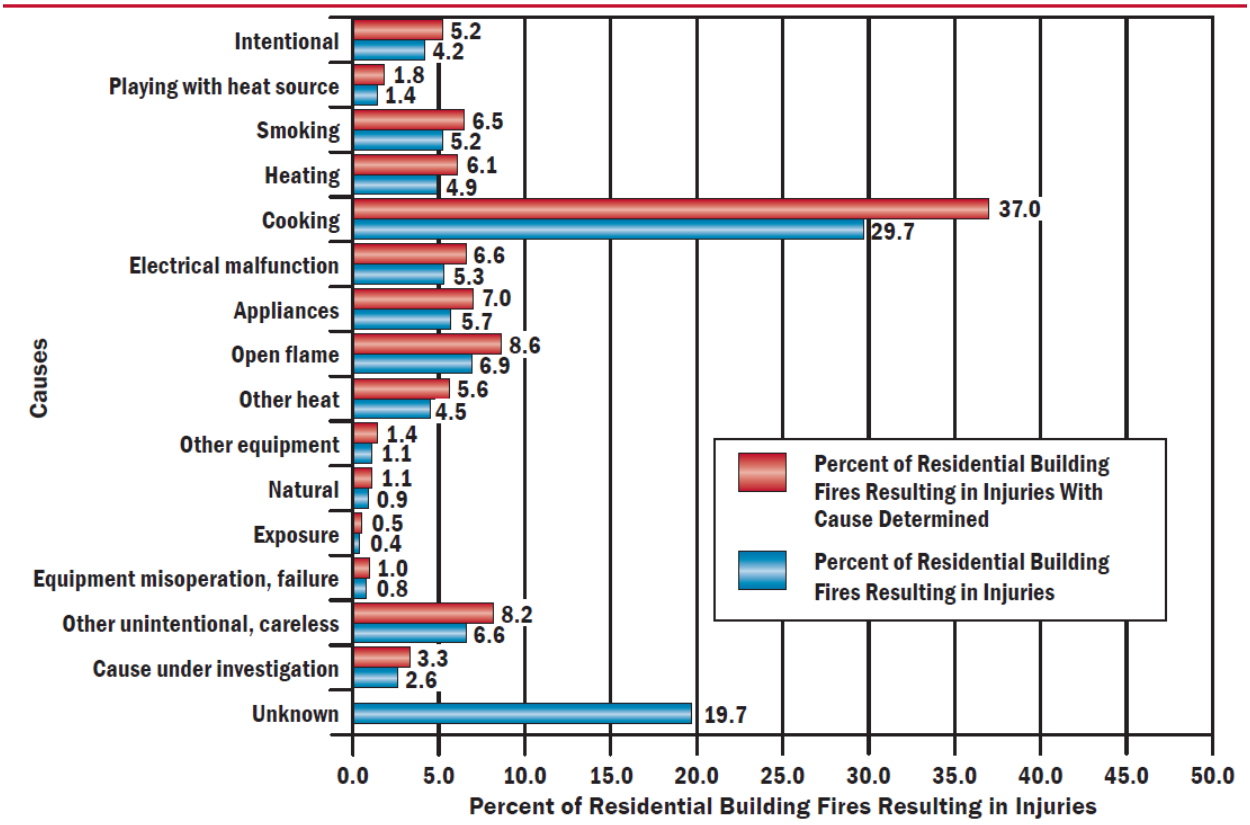

Figure 3. Causes of Residential Building Fires Resulting in Injuries (2012-2014). Adapted from "Civilian Fire Injuries in Residential Buildings," by USFA, 2016, p. 6.

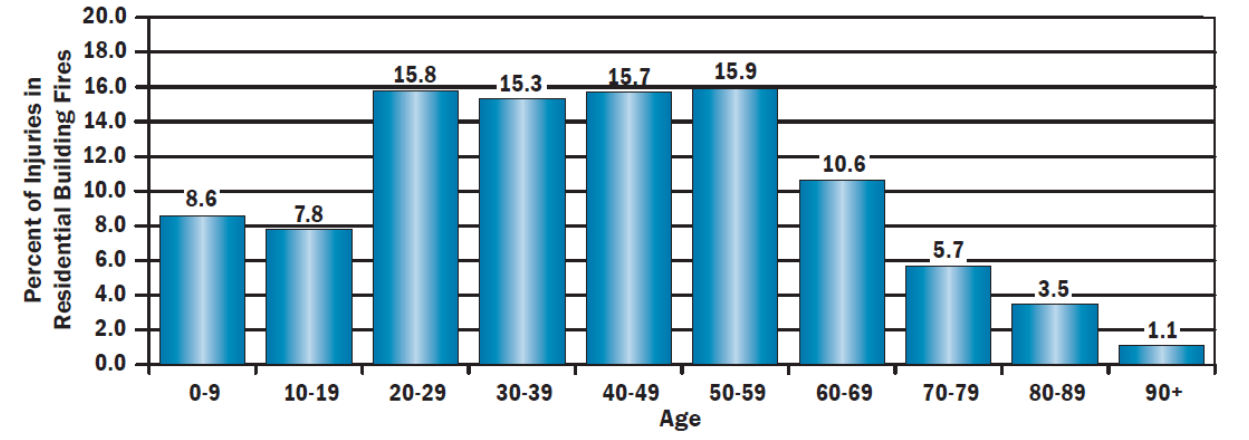

Figure 4. Civilian Fire Injuries in Residential Buildings by Age Group (2012-2014). Adapted from "Civilian Fire Injuries in Residential Buildings," by USFA, 2016, p. 8.

For its research, the NFPA tracks fires in RVs as a category of highway vehicle fire. They point out that the term "highway vehicle fires" is used to describe the type of vehicle, not the location of the fire. Their data shows that 49% of vehicle fires were caused by a mechanical failure or malfunction, and 23% of the fires were caused by an electrical malfunction. Furthermore, 64% of vehicle fires began in the engine, running gear, or wheel area (Ahrens, 2010).

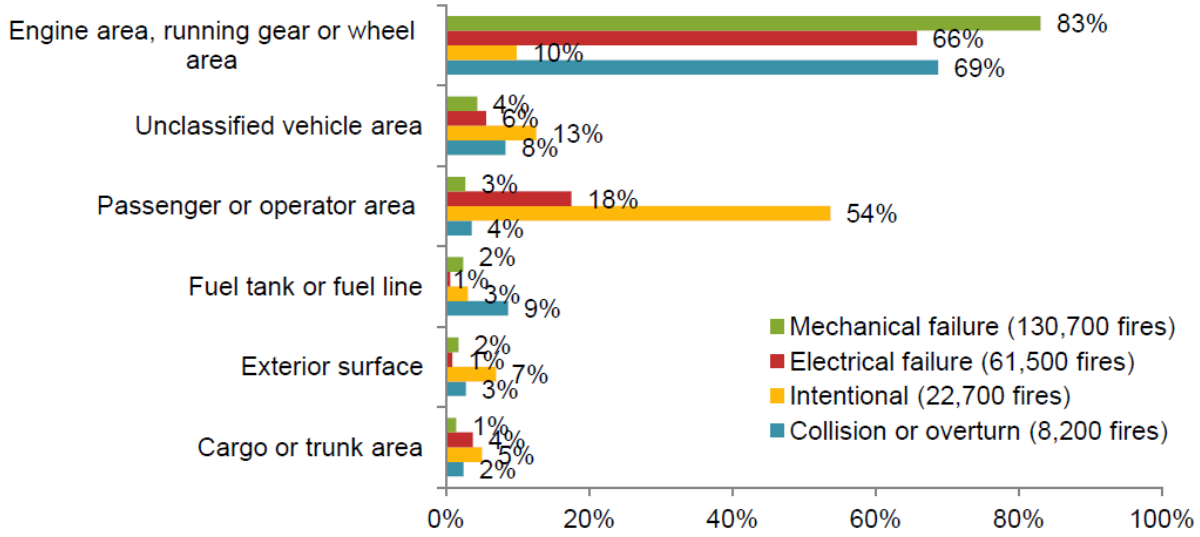

Figure 5. Area of Origin in 2003-2007 Vehicle Fires, by Fire Causal Factor. Adapted from "U.S. Vehicle Fire Trends and Patterns," by M. Ahrens, 2010, p. 19. Copyright 2010 by National Fire Protection Association.

Table 2

U.S. Vehicle Fire Problem, by Type of Vehicle 2003-2007 Annual Averages

Vehicle Type	Fires	Civilian Deaths	Civilian Injuries	Direct Property Damage (in Millions)
Motorhome, camper, or bookmobile	2,920 (1%)	5 (1%)	62 (4%)	$39 (3%)
Travel trailer designed to be towed	1,330 (0%)	2 (0%)	21 (1%)	$9 (1%)
Collapsible camping trailer	200 (0%)	1 (0%)	4 (0%)	$1 (0%)

Note. Adapted from "U.S. vehicle fire trends and patterns," by M. Ahrens, 2010, p. 11. Copyright 2010 by NFPA.

According to McCoy (n.d.), engine compartment fires account for 70% of fires in RVs, tire and wheel fires account for 20%, while the remaining causes of fires vary widely. Generators, fuel leaks, solar power problems, propane leaks, and batteries have all been identified as potential causes. The Good Sam Insurance Agency, a firm that specializes in RV insurance, lists the top five claims as being tire blowouts, refrigerator fires, propane leaks, hitting gas station overhangs and bridges, failure to stow retractable steps and awnings, and animal infestations ("Top RVing Mishaps," n.d.).

Refrigerator fires in RVs have received attention in previous years and have been subject to recalls by the National Highway and Traffic Safety Administration (NHTSA). The most common type of refrigerator used in RVs is the absorption type that functions without a compressor or moving parts common to a traditional residential refrigerator. These refrigerators operate chemically using water, ammonia, hydrogen, and sodium chromate. Cooling is achieved through a series of chemical reactions initiated by heating from a boiler which causes the ammonia to circulate through the system. In most cases these refrigerators utilize both an electrical heating element as well as a propane burner to heat the boiler region of the refrigerator. Failure occurs when a crack forms near the boiler unit that causes ammonia and hydrogen to escape. If within the proper flammable range, this release can cause a fire event (Keifer, Layson, & Wensley, 2008).

The *NFPA Journal* describes a few examples of RV fires that have occurred over the past several years. In one case, an 8-year-old girl died from smoke inhalation and burns while living in an RV parked in a salvage yard. Investigators found two portable electric heaters and one portable propane heater being used for heat. The heaters being placed too close to combustible items are believed to start the fire (Tremblay, 2011). In another case, a travel trailer parked in a

storage facility caught fire. The fire was controlled by sprinklers installed in the storage facility limiting the fire to the travel trailer itself. Investigators found that the owner had plugged an external extension cord into the stowed shore power cord that was coiled in its storage compartment. An electric space heater was powered inside the RV at the time. It is believed that resistant heating ignited the cord (Ken, 2012).

In a final example, a motorhome traveling on an interstate highway had a failure of the right front tire. The tire failure caused the RV to lose control and a fire broke out in the wheel well involving the generator and fuel lines. The fire being at the right front of the vehicle blocked the primary exit forcing the three occupants to attempt to escape through a window at the rear of the vehicle. The occupants were unable to escape which resulted in them succumbing to fatal injuries (Badger, 2013).

According to the National Motor Vehicle Crash Causation Survey, 94% of vehicle crashes can be attributed to a vehicle driver, 2% can be attributed to a failure or degradation of a vehicle component, and 2% can be attributed to the environment. Among driver related causes, decision errors, or those related to driving too fast for conditions, too fast for a curve, or a false assumption of other driver actions account for 33% of driver caused crashes. Performance errors, or those relating to vehicle handling characteristics such as overcompensation, and poor directional control account for 11% of drive caused crashes. Of vehicle related crash causes, tire and wheel related issues account for 33% of crashes, and brake related issues account for 22%. Of environmental related causes, slick roads account for over 50% of crashes (Singh, 2015).

RVs have different handling characteristics than passenger cars and light trucks. Due to the size of the vehicles, RVs may have limited visibility, take turns wider, have longer braking distances and have more difficulty negotiating terrain. As the wheelbase of a vehicle increases,

the off-tracking of the rear wheels becomes more pronounced. As the rear wheels do not follow the same path as the front wheels, turns must be taken wider. Towed RVs pose additional challenges in that the wheels of a trailer tend to track to the inside of the turn in comparison to the tow vehicle. RV operators must drive slower, brake sooner, and allow for greater following distances in order to compensate for vehicle performance. They must also be aware of the weight and height of the vehicle to ensure that bridges, overpasses, and other overhead obstructions can be safely navigated (Solberg, 2011).

In the case of towed RVs, it is important that the trailer is matched to an appropriate tow vehicle. When a truck pulls a trailer, a single vehicle is created from three distinct systems. The ratings of these systems: the truck, the trailer, and the connectors, must be coordinated to create a single unit that can operate safely. The truck and trailer are each rated by their manufacturers to carry a specific payload. Furthermore, the tow vehicle is rated for a combined weight rating that the truck and trailer together cannot exceed. There are additional weight restrictions for each axel, and each tire of the combined vehicle, as well as ratings for the towing receivers, hitches, and balls. Exceeding any single rating in the combined vehicle package can compromise the handling of the vehicle, increase the probability of a component failure, and increase the likelihood of an accident (Whitford et al., 2014).

The handling behavior of a tow vehicle and trailer combination is more complex and less predictable than that of non-articulated vehicles. Conditions that may upset the stability of this system include lane changes, crosswinds, road irregularities, sudden stops, or obstacle avoidance (Zhou, Zhang, & Zhao, 2010). An upset in the stability of the system may result in trailer sway, jack-knifing, or rollover condition. Jack-knifing is one of the most common accident causes for tow vehicle and trailer combinations. It is mainly attributed to the tires of a trailer having

insufficient friction with the road during a turn, or during rapid deceleration. This may lead the trailer to swing around causing the articulation between the tow vehicle and trailer to exceed the limit in which the vehicle can be controlled. Factors that may contribute to a rollover are high speed around a curved path such as merging on to a highway, sudden course deviations such as during a lane change, or a load shift on the trailer (Sun, He, Esmailzadeh, & Ren, 2012).

According to Ehringer (2013), tire failure is the second leading cause of trailer accidents after driver error. Trailer tires are more susceptible to failure because in most cases they are not often used. Rubber tires that are not used are subject to deterioration, rot, delamination, and cracking. These can be exacerbated by being stored in direct sunlight, not maintaining the proper cold inflation pressure, and not being stored on an intact level surface. Additionally, a vehicle or trailer that exceeds the designed load rating of the tire can lead to failure. These are among the reasons it is recommended that trailer and RV tires should be inspected before each use, and replaced every few years regardless of tread depth and mileage on the tires (Jones, 2010).

Procedures

A descriptive research methodology was employed to address the transportation, construction, and occupant behaviors that may lead to fire and safety hazards in recreational vehicles. A literature review focused on the demographics of RV ownership in the United States, the fire hazards associated with motor vehicles, the fire hazards associated with residential structures, vehicle crashes, and the contributing factors that lead to them. Publications and statistics from federal agencies such as the U.S. Fire Administration, U.S. Department of Transportation, and Centers for Disease Control and Prevention were analyzed as well as research compiled by the National Fire Protection Association. Articles and research

from RV specific sources were utilized where available. Finally, as part of the literature review and an internet search of RV industry related organizations, the regulatory and safety standards applicable to recreational vehicles were identified.

I requested Texas Fire Incident Reporting System (TEXFIRS) data from the Texas State Fire Marshal's Office which is the entity that collects NFIRS data on behalf of fire departments in Texas. I requested data related to fires and motor vehicle accidents involving recreational vehicles (campers, motorhomes, travel trailers). For fires I requested property use, causes, place of origin, injuries, and fatalities for all incidents coded 122, 136, 137, or any other fire incident where the mobile property type is 14. For motor vehicle accidents I requested incidents coded 322, 324, and 352 where the mobile property type is 14. To ensure the data is currently relevant, I requested the data for the time period of 2011-2105. The Texas Fire Marshal's Office was able to provide the fire related data, but was unable to provide the vehicle accident data as they could not reference back to a mobile property type.

Without being able to ascertain the motor vehicle accident data from TEXFIRS, I requested vehicle accident statistics from the Texas Department of Transportation. I requested crash data for all incidents involving motorhomes, travel trailers, and camper trailers over the period of 2011-2015. They were unable to provide any data as they do not specifically track those vehicle types.

Due to the lack of data available specific to the research questions, I conducted an on-line survey of other fire departments in the United States. The author used surveymonkey.com to develop and deliver the survey. A survey participation request was published in The Friday Report, which is a weekly e-mail based newsletter that gets distributed to all members of the Texas Fire Chiefs Association. I also sent the survey request to a network of Executive Fire

Officer Program alumni and participants to broaden the geographic distribution of survey respondents. The survey asked 13 questions related to the research questions. The survey questions were guided by the literature review as well as additional information gained from non-academic sources such as news stories, RV owner blogs, and industry trade publications. 63 survey responses were received.

There are a number of limitations to this research. First of all, there is very little current academic research related to recreational vehicles. Of that which is current, the majority of it deals with the demographics and social habits of RV owners. The majority of the safety related research identified was conducted in the late 1970's and early 1980's.

Another limitation to the research is the nature of recreational vehicles themselves, being that they are both a vehicle and a type of occupancy. This is demonstrated in the way they are regulated as well as the way statistics are tracked. For example, RVs are included in NFPA research on residential fires, as well as being included in their research on vehicle fires. Likewise, when trying to obtain vehicle accident statistics, RVs are included in the broad category of passenger vehicles.

Finally, another limitation is the reliability of the data itself. Upon review of the TEXFIRS data, it became clear that the definition of recreational vehicle may not be universally agreed upon. In cases where the mobile property type was listed as boat or motorcycle, I excluded the data. Additionally, many of the NFIRS classification do not have sufficient specificity to truly narrow down the fire causes. Additionally, the quality of the data is reliant upon the proper NFIRS codes being selected by those who entered it. The survey results are subject to the same limitations, as well as the assumption that in many cases fire and accident

causes are undetermined or insufficiently investigated to the level of detail this research attempts to answer.

Results

Data from both TEXFIRS and the survey I distributed were used to address the first three research questions. The TEXFIRS data shows that between 2011 and 2015 there were 1,770 fire incidents involving recreational vehicles in Texas. To identify incidents involving RVs, data was selected using NFIRS 5.0 incident codes 122, 136, and 137. Code 122 is defined as "Fire in a motor home, camper, or recreational vehicle when used as a structure. Includes motor homes when not in transit and used as a structure for residential purposes" (USFA, 2015, p. 3-22). Code 136 is defined as "Self-propelled motor home or recreational vehicle. Includes only self-propelled motor homes or recreational vehicles when being used in a transport mode. Excludes those used for normal residential use (122)" (USFA, 2015, p. 3-22). Code 137 is defined as "Camper or recreational vehicle (RV) fire, not self-propelled. Includes trailers. Excludes RVs on blocks or used regularly as a fixed building (122) and the vehicle towing the camper or RV or the campers mounted on pick-ups (131)" (USFA, 2015, p. 3-22).

The first three research questions ask: *What transportation related factors create fire and safety hazards in recreational vehicles? (b) What construction related factors create fire and safety hazards in recreational vehicles? (c) What occupant behaviors create fire and safety hazards in recreational vehicles.* The survey asks "Has your Fire Department responded to a fire incident involving a recreational vehicle within the past five years?"

Has your Fire Department responded to a fire incident involving a recreational vehicle within the past five years?		
Answer Options	Response Percent	Response Count
Yes	79.4%	50
No	20.6%	13

Figure 6.

Figure 6 shows that 79.4% of respondent fire departments have responded to a fire involving a recreational vehicle. The survey then asks "How many fire incidents involving recreational vehicles have you responded to within the past five years?"

How many fire incidents involving recreational vehicles have you responded to within the past five years?		
Answer Options	**Response Percent**	**Response Count**
1-5	82.6%	38
6-10	6.5%	3
11-15	2.2%	1
16 or more	8.7%	4

Figure 7.

Figure 7 shows that 82.6% of respondents have responded to 1-5 RV fires within the past five years, indicating RV fires are not very common. According to the TEXFIRS data, there were 1,770 RV fires in Texas between 2011-2015. The next question asks "Where has your department encountered fire incidents in recreational vehicles?"

Where has your department encountered fire incidents in recreational vehicles? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
On a public or private roadway	69.6%	32
In an RV park or campsite	43.5%	20
In a storage lot or parking facility	26.1%	12
Parked at a private residence or business	47.8%	22
Other (please specify)	10.9%	5

Figure 8.

Figure 8 shows where the respondents have encountered RV fire incidents. The survey results indicate that fire incidents are most likely to be encountered on a roadway. The TEXFIRS data had too many property use variables to interpret any meaningful data. The next question asks "In what scenarios has your department encountered RV fire incidents?"

In what scenarios has your department encountered RV fire incidents? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
While traveling	73.3%	33
While being occupied	64.4%	29
While being stored	44.4%	20

Figure 9.

Figure 9 shows that 73.3% of respondents have responded to a recreational vehicle while traveling. 64.4% have encountered an RV fire while it is occupied, and 44.4% have responded to an RV fire in storage. In the TEXFIRS data, there were 803 incidents, or 45.4% reported as incident code 122 or another code for a fire in an occupied structure. The remainder of the incidents used a code indicating the fires occurred while the vehicle was in transit. The next question, "What mechanical causes of RV fires has your department encountered?" This question relates to both transportation and construction related causes.

What mechanical causes of RV fires has your department encountered? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fuel leak	14.0%	6
Propane leak	23.3%	10
Engine fire	53.5%	23
Tire or brake fire	20.9%	9
Refrigerator fire	9.3%	4
Other appliance fire	7.0%	3
Electrical fire	62.8%	27
Other (please specify)	11.6%	5

Figure 10.

Figure 10 shows that electrical fires, followed by engine fires are the most common mechanical fire causes in RVs. In the TEXFIRS data, only 181 or 10.2% of the incidents listed "engine area, running gear, wheel area" as the location of fire origin. The next question asks "What human factors related to RV fires has your department encountered?"

What human factors related to RV fires has your department encountered? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Unattended cooking	17.6%	6
Improperly discarded smoking materials	29.4%	10
Arson	20.6%	7
Use of space heater or other heating appliance	29.4%	10
Use of candles	5.9%	2
Other (please specify)	41.2%	14

Figure 11.

Figure 11 indicates that smoking, and the use of supplemental heating appliances are leading human behavior causes of RV fires. Several comments made in the "other" category include lack of maintenance as a cause. The TEXFIRS data shows that 172 incidents, or 9.7% of fires starting in the kitchen area, and 91 incidents, or just over 5% listed as "incendiary/suspicious". The next two questions ask about civilian and firefighter injuries and fatalities related to RV fires.

Has your department ever experienced a civilian fatality or injury requiring hospitalization due to an RV fire? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fatality inside a towed RV	2.4%	1
Fatality inside a motorhome	9.8%	4
Severe injury inside a towed RV	2.4%	1
Severe injury inside a motorhome	9.8%	4
No	80.5%	33

Figure 12.

Has your department ever experienced a firefighter fatality or injury requiring hospitalization due to an RV fire? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fatality fighting a fire	0.0%	0
Injury fighting a fire	4.8%	2
No	95.2%	40

Figure 13.

Figures 12 and 13 show that fire fatalities and injuries in RV fires are infrequent. The TEXFIRS data shows that between 2011 and 2015 there were 17 civilian fatalities, 33 civilian

injuries, zero firefighter fatalities, and 14 firefighter injuries related to RV fires. The next questions ask about fire department experience with vehicle accidents involving an RV.

Has you fire department responded to a vehicle crash involving an RV within the past five years?		
Answer Options	**Response Percent**	**Response Count**
Yes	50.9%	28
No	49.1%	27

Figure 14.

Figure 14 shows that approximately one half of respondents have encountered a vehicle accident involving an RV.

How many crashes involving recreational vehicles have you responded to within the past five years?		
Answer Options	**Response Percent**	**Response Count**
1-5	85.2%	23
6-10	7.4%	2
11-15	0.0%	0
16 or more	7.4%	2

Figure 15.

Figure 15 shows that RV vehicle accidents are an infrequent event. The next question asks whether the RV accident was a single vehicle accident, or whether other vehicles were involved.

Which of the following scenarios has your department responded to? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
The RV was the only vehicle involved	48.1%	13
The RV struck or was struck by another vehicle	92.6%	25

Figure 16.

Figure 16 shows that in most cases, RV crashes involve another vehicle. Next, the survey asks “What mechanical causes of RV crashes has your department experienced?”

What mechanical causes of RV crashes has your department experienced? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fire	30.8%	8
Tire or wheel failure of towed RV	26.9%	7
Tire or wheel failure of motorhome or tow vehicle	34.6%	9
Separation of trailer from tow vehicle	26.9%	7
Other (please specify)	38.5%	10

Figure 17.

Fires, tire or wheel failures, and trailer separations all appear to be significant causes for vehicle accidents involving RVs. No clear trend emerges from the "other" category. The next question asks "What human factors of RV crashes has your department encountered?"

What human factors of RV crashes has your department encountered? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Loss of control	77.8%	21
Severe weather	22.2%	6
Overloading of vehicle	18.5%	5
Turned too tight	14.8%	4
Vehicle ran off edge of road	59.3%	16
Failed to secure antennas, steps, slide outs, or other protrusions from vehicle	0.0%	0
Other (please specify)	11.1%	3

Figure 18.

Figure 18 indicates that failure to maintain control of the vehicle is the leading human factor related to vehicle accidents involving RVs. The final survey question asks about fatalities and injuries related to a vehicle accident involving an RV.

Has your department ever experienced a civilian fatality or injury requiring hospitalization due to an RV crash? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fatality in a motorhome	7.4%	2
Fatality in a tow vehicle	11.1%	3
Fatality in a vehicle that struck or was struck by an RV	18.5%	5
Severe injury in a motorhome	22.2%	6
Severe injury in a tow vehicle	3.7%	1
Severe injury in a vehicle that struck or was struck by an RV	18.5%	5
None	66.7%	18

Figure 19.

Figure 19 shows that fatalities and injuries are rare. Injury rates in a motorhome accidents appear to be higher than in a tow vehicle. Injuries and fatalities seem to happen at a higher rate in vehicles struck by an RV.

The final research question asks: *What fire and safety standards exist for recreational vehicles?* The U.S. Department of Housing and Urban Development (HUD) regulates the construction of manufactured housing. While RVs are similar in construction to manufactured homes, they are specifically exempt from HUD regulation. HUD defines a recreational vehicle as a vehicle built on a single chassis; is 400 square feet or less; self-propelled or permanently towable by a light duty truck; and designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use (Manufactured Home Procedural and Enforcement Regulations, 2010).

The U.S. Department of Transportation regulates RVs as vehicles. The Federal Motor Vehicle Safety Standards regulates certain components of RVs such as bumper impact, lighting, seat belts, flammability standards for some interior materials, and the selection of tire and rims based on vehicle load capacity (Federal Motor Vehicle Safety Standards, 1967). Additionally, RV manufactures must comply with 49 CFR 573 as it relates to notifying the NHTSA of product

defects. Certain components of towable RVs are also subject to regulation by the Consumer Product Safety Commission such as mattresses in 16 CFR 1633.

The Recreational Vehicle Industry Association, which represents the majority of RV manufactures in the United States, has adopted the following standards: the RVIA/ANSI Low Voltage System Standard; the 120-volt electrical requirements specified in NFPA 70 National Electric Code; and the fire & life safety, plumbing, and fuel systems and equipment sections of NFPA 1192 Standard on Recreational Vehicles ("Standards," n.d.).

Among the provisions of NFPA 1192 are standards for propane storage and plumbing, flammability of interior finishes, and escape routes. Required safety equipment includes a smoke alarm, carbon monoxide detector, propane detector, and a portable fire extinguisher (NFPA, 2015).

Discussion

Fjelstul (2013) states “the uniqueness of RV travel is the dual role of the recreational vehicle serving the traveler as both their transportation and lodging" (p.1). Because of this, RVs are classified both as a vehicle and as an occupancy type depending on their state of transit and therefore inherit the traits and hazards of both.

The first research question asks: *What transportation related factors create fire and safety hazards in recreational vehicles?* As RV are a type of vehicle, they have many of the same risks associated with other vehicle types. Consistent with the NFPA’s research on vehicle fires, engine fires appear to be the most common fire type on a motorized RV in transit (Ahrens, 2010). According to the survey data, nearly 80% of respondent fire departments have responded to an RV fire, and 73.3% of them responded to an RV fire while it was traveling. As towed RVs do not have an engine, it appears that fires in transit are significantly less likely than those in a

self-propelled RV. Tire or wheel failures are a leading mechanical cause of vehicle accidents involving RVs. This is consistent with the U.S. Department of Transportation's finding that tire failures account for 33% of accidents where a mechanical failure is the primary cause (Singh, 2015).

Tires are a specific area of concern as according to Curtin (2011), RVs are typically only used for 20 days out of a year. Tires that are not routinely used are subject to degradation from the elements as well as the possibility of bearing too much weight if not kept properly inflated (Ehringer, 2013). RV owners may get a false sense of security by thinking that tires that look serviceable externally are safe to use when in fact they may be failing internally.

The second research question asks: *What construction related factors create fire and safety hazards in recreational vehicles?* RV construction is series of compromises based on the desire to minimize weight and cost. Being that an RV is both a vehicle and an occupancy, a proper balance must be achieved to effectively accomplish both roles. RVs are a form of manufactured housing as they are built in a factory. In many cases they resemble manufactured homes, but are not subject to same regulations. RVs are built with a variety of lightweight, synthetic materials including plywood, particleboard, glues, foams, plastics, and fiberglass. These materials have low mass, high fuel load, and toxic byproducts of combustion (Bowker, 2010).

In addition to the lightweight constructions materials, nearly all RVs have the following components: propane storage and distribution systems for heating, cooking, and refrigeration; 12 volt and 120 volt electrical systems; and in the case of motorized RVs, an engine with requisite gasoline or diesel fuel storage. Most motorized, and some towable RVs, have a gasoline or diesel powered generator as well (Solberg, 2011).

These hazards are all packaged in a unit that is in most cases is less than 400 square feet. In the event of a fire or other hazardous condition, it can be expected that fire spread will be rapid, and time to escape will be limited.

The third research question asks: *What occupant behaviors create fire and safety hazards in recreational vehicles?* According to the survey, the occupant behaviors that most often contribute to fires in RVs are smoking, and the use of portable heating appliances. In comparison, the USFA's data show that cooking is by far the largest fire cause where someone is injured, and smoking is one of the largest causes of fatal fires. Heating and appliances are not significant causes of fires that cause injuries or fatalities in most residential structures (USFA, 2016). It should be noted that the median age of RV owner is 48 years old. This is near or within the same age ranges that have among the highest rates of injuries and fatalities due to fires in residential structures (USFA, 2016).

As far as transportation incidents, failure of the driver to maintain control of the vehicle is the most significant cause of vehicle accidents, as cited by over 77% of the survey respondents. This compares with the U.S. Department of Transportation study that says that 94% of all vehicle crashes are the result of the actions of the driver (Singh, 2015).

The last research question asks: *What fire and safety standards exist for recreational vehicles?* As far as federal regulations, RVs are for the most part only regulated under the Federal Motor Vehicle Safety Standards. In the eyes of the federal government RVs are considered vehicles and are exempt from housing regulations. The RV industry, by way of the RVIA, has adopted portions NFPA 1192 and NFPA 70, as well as co-developed its own low voltage standard; however, these are voluntarily adopted standards rather than a statutory

requirement. It appears to be fortunate that RVs are required to report safety related defects to NHTSA because a search of their website shows a significant amount of RV recalls.

In summary, RV fires are relatively rare events. In 2014, fire departments in Texas responded to 72,124 fires. According to the 2014 TEXFIRS data, only 372 involved an RV which is not a statistically significant figure. In that same year 3 out of 163 fire fatalities were the result of an RV fire, again a statistically insignificant number (Texas Department of Insurance, 2015).

With that being said, nearly 8.5% of households in the U.S. own an RV, so a significant portion of the U.S. population travels in and resides in an RV at some point.

Recommendations

This research demonstrates that recreational vehicles share similar characteristics and hazards to both residential structures as well as vehicles. Being that RVs are of such a hybrid nature, the available research and methods of capturing data are insufficient to accurately portray the issues related specifically to RVs.

While data relating to fires in residential structures is readily available, including RVs in this data may not be appropriate due to the fact that RVs are intended for temporary occupancy, are frequently transported, and do not have the same types of utility connections as a residence intended in long term occupancies. Being that fire events in RVs are not broken out from fires in other types of structures, it is difficult to evaluate the relative risks.

Likewise, RVs are included in federal statistics for vehicle crashes, however the data is not specific enough to identify trends specific to RVs. Crash data compiled by the US Department of Transportation is not specific enough for the variety of vehicle types. There is no

way of identifying accidents involving light trucks towing trailers, and the types of trailers being towed.

The first recommendation is that all fire departments need to be better trained in NFIRS data entry. A lack of understanding of the definitions of the different incident codes and occupancy types means that there is high degree of variability of what actually gets entered into an incident report. This variability means that data extracted from NFIRS is suspect. The TEXFIRS data used in this research made it clear that there is a lack of consistency in how incidents get classified.

The second recommendation is that NFIRS and US DOT data needs to allow more specificity to make identification of RV incidents more readily identifiable, as well as making it easier for those entering data to select the proper incident types. Many of the incident types and descriptors are either too general, or too similar, making it difficult to select the appropriate choice.

The third recommendation is that the RV industry itself must push for more research to identify and mitigate the hazards unique to the industry. Research on customer demographics and buying trends are readily available, but there exists little in terms of vehicle safety and occupant safety.

From an organizational perspective, training on how fires and other incidents involving recreational vehicles differ from other vehicle types and residential structures is essential to mitigate the incidents in way a that provides the greatest likelihood for a successful outcome.

While fire and vehicle accident related events involving recreational vehicles are relatively infrequent, they do occur and there seems to be little effort to specifically identify and address them. As the RV industry continues to grow, and RV ownership continues to rise, fire

and other safety related incidents are likely to increase as well. The RV industry as well as the fire service need to invest more resources to prepare for these events.

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Appendix A: Survey

The purpose of this survey is to ascertain fire department experience with fire events and crashes involving recreational vehicles. For the purpose of this survey, a recreational vehicle may be a self-propelled motorhome, or a travel trailer, fifth-wheel trailer, or pop-up camper towed by another vehicle.

Fire and Safety Hazards of Recreational Vehicles

1. Has your Fire Department responded to a fire incident involving a recreational vehicle within the past five years?
Yes
No

2. How many fire incidents involving recreational vehicles have you responded to within the past five years?
1-5
6-10
11-15
16 or more

3. Where has your department encountered fire incidents in recreational vehicles? (Check all that apply)
On a public or private roadway
In an RV park or campsite
In a storage lot or parking facility
Parked at a private residence or business
Other (please specify)

4. In what scenarios has your department encountered RV fire incidents? (Check all that apply)
While traveling
While being occupied
While being stored

5. What mechanical causes of RV fires has your department encountered? (Check all that apply)
Fuel leak
Propane leak
Engine fire
Tire or brake fire
Refrigerator fire
Other appliance fire
Electrical fire
Other (please specify)

6. What human factors related to RV fires has your department encountered? (Check all that apply)
Unattended cooking
Improperly discarded smoking materials
Arson
Use of space heater or other heating appliance
Use of candles
Other (please specify)

7. Has your department ever experienced a civilian fatality or injury requiring hospitalization due to an RV
fire? (Check all that apply)
Fatality inside a towed RV
Fatality inside a motorhome
Severe injury inside a towed RV
Severe injury inside a motorhome
No

8. Has your department ever experienced a firefighter fatality or injury requiring hospitalization due to an
RV fire? (Check all that apply)
Fatality fighting a fire
Injury fighting a fire
No

9. Has you fire department responded to a vehicle crash involving an RV within the past five years?
Yes
No

10. How many crashes involving recreational vehicles have you responded to within the past five years?
1-5
6-10
11-15
16 or more

11. Which of the following scenarios has your department responded to? (Check all that apply)
The RV was the only vehicle involved
The RV struck or was struck by another vehicle

12. What mechanical causes of RV crashes has your department experienced? (Check all that apply)
Fire
Tire or wheel failure of towed RV
Tire or wheel failure of motorhome or tow vehicle
Separation of trailer from tow vehicle
Other (please specify)

13. What human factors of RV crashes has your department encountered? (Check all that apply)
Loss of control
Severe weather
Overloading of vehicle
Turned too tight
Vehicle ran off edge of road
Failed to secure antennas, steps, slide outs, or other protrusions from vehicle
Other (please specify)

14. Has your department ever experienced a civilian fatality or injury requiring hospitalization due to an RV
crash? (Check all that apply)
Fatality in a motorhome
Fatality in a tow vehicle
Fatality in a vehicle that struck or was struck by an RV
Severe injury in a motorhome
Severe injury in a tow vehicle
Severe injury in a vehicle that struck or was struck by an RV
None

Appendix B: Survey Results

1.

Has your Fire Department responded to a fire incident involving a recreational vehicle within the past five years?		
Answer Options	**Response Percent**	**Response Count**
Yes	79.4%	50
No	20.6%	13
	answered question	**63**
	skipped question	**0**

2.

How many fire incidents involving recreational vehicles have you responded to within the past five years?		
Answer Options	**Response Percent**	**Response Count**
1-5	82.6%	38
6-10	6.5%	3
11-15	2.2%	1
16 or more	8.7%	4
	answered question	**46**
	skipped question	**17**

3.

Where has your department encountered fire incidents in recreational vehicles? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
On a public or private roadway	69.6%	32
In an RV park or campsite	43.5%	20
In a storage lot or parking facility	26.1%	12
Parked at a private residence or business	47.8%	22
Other (please specify)	10.9%	5
	answered question	**46**
	skipped question	**17**

Number	Response Date	Other (please specify)	Categories
1	Sep 13, 2016 1:50 AM	Truck Stop	
2	Sep 9, 2016 4:42 PM	Wooded land and open fields.	
3	Sep 9, 2016 4:12 PM	stored inside a warehouse	
4	Sep 8, 2016 3:39 AM	off-road, wilderness trails	
5	Sep 7, 2016 11:08 PM	Airport Property	

4.

In what scenarios has your department encountered RV fire incidents? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
While traveling	73.3%	33
While being occupied	64.4%	29
While being stored	44.4%	20
	answered question	**45**
	skipped question	**18**

5.

What mechanical causes of RV fires has your department encountered? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fuel leak	14.0%	6
Propane leak	23.3%	10
Engine fire	53.5%	23
Tire or brake fire	20.9%	9
Refrigerator fire	9.3%	4
Other appliance fire	7.0%	3
Electrical fire	62.8%	27
Other (please specify)	11.6%	5
	answered question	**43**
	skipped question	**20**

Number	Response Date	Other (please specify)	Categories
1	Sep 10, 2016 5:46 PM	Undetermined	
2	Sep 9, 2016 6:19 PM	unknown	
3	Sep 9, 2016 5:37 PM	Operator Error	
4	Sep 9, 2016 2:30 AM	Engine	
5	Sep 7, 2016 10:40 PM	No Determined - Started in motor - Vehicle Parked/Running on side of road.	

6.

What human factors related to RV fires has your department encountered? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Unattended cooking	17.6%	6
Improperly discarded smoking materials	29.4%	10
Arson	20.6%	7
Use of space heater or other heating appliance	29.4%	10
Use of candles	5.9%	2
Other (please specify)	41.2%	14
	answered question	34
	skipped question	29

Number	Response Date	Other (please specify)	Categories
1	Sep 10, 2016 3:39 PM	lack of maintenance/upkeep	
2	Sep 9, 2016 6:19 PM	none	
3	Sep 9, 2016 5:45 PM	Stacked materials against a light	
4	Sep 9, 2016 5:44 PM	lack of maintenance	
5	Sep 9, 2016 2:31 AM	N/A	
6	Sep 8, 2016 3:54 PM	Starting furnace with gas leak	
7	Sep 8, 2016 2:19 PM	N/A	
8	Sep 8, 2016 12:18 AM	engine fires, poor maintenance	
9	Sep 7, 2016 11:49 PM	Impaired occupants	
10	Sep 7, 2016 11:09 PM	Improper storage of RV inside Aircraft Hangar	
11	Sep 7, 2016 10:41 PM	None	
12	Sep 7, 2016 10:10 PM	Didn't stop when they smelled smoke. Made fire bigger.	
13	Sep 7, 2016 9:51 PM	Lack of maintenance	
14	Sep 7, 2016 9:26 PM	N/a	

7.

Has your department ever experienced a civilian fatality or injury requiring hospitalization due to an RV fire? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fatality inside a towed RV	2.4%	1
Fatality inside a motorhome	9.8%	4
Severe injury inside a towed RV	2.4%	1
Severe injury inside a motorhome	9.8%	4
No	80.5%	33
	answered question	**41**
	skipped question	**22**

8.

Has your department ever experienced a firefighter fatality or injury requiring hospitalization due to an RV fire? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fatality fighting a fire	0.0%	0
Injury fighting a fire	4.8%	2
No	95.2%	40
	answered question	**42**
	skipped question	**21**

9.

Has you fire department responded to a vehicle crash involving an RV within the past five years?		
Answer Options	**Response Percent**	**Response Count**
Yes	50.9%	28
No	49.1%	27
	answered question	**55**
	skipped question	**8**

10.

How many crashes involving recreational vehicles have you responded to within the past five years?		
Answer Options	**Response Percent**	**Response Count**
1-6	85.2%	23
6-10	7.4%	2
11-15	0.0%	0
16 or more	7.4%	2
	answered question	27
	skipped question	36

11.

Which of the following scenarios has your department responded to? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
The RV was the only vehicle involved	48.1%	13
The RV struck or was struck by another vehicle	92.6%	25
	answered question	27
	skipped question	36

12.

What mechanical causes of RV crashes has your department experienced? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fire	30.8%	8
Tire or wheel failure of towed RV	26.9%	7
Tire or wheel failure of motorhome or tow vehicle	34.6%	9
Separation of trailer from tow vehicle	26.9%	7
Other (please specify)	38.5%	10
	answered question	26
	skipped question	37

Number	Response Date	Other (please specify)	Categories
1	Sep 10, 2016 3:40 PM	operator error	
2	Sep 9, 2016 5:46 PM	Inattentive Drivers	
3	Sep 9, 2016 4:15 PM	N/A	
4	Sep 8, 2016 7:46 PM	None of the above.	
5	Sep 8, 2016 2:39 PM	Unknown	
6	Sep 8, 2016 2:20 PM	Human	
7	Sep 7, 2016 10:39 PM	Trailer struck by another vehicle	
8	Sep 7, 2016 9:52 PM	Undetermined	
9	Sep 7, 2016 9:36 PM	Car crash	
10	Sep 7, 2016 9:30 PM	all human error	

13.

What human factors of RV crashes has your department encountered? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Loss of control	77.8%	21
Severe weather	22.2%	6
Overloading of vehicle	18.5%	5
Turned too tight	14.8%	4
Vehicle ran off edge of road	59.3%	16
Failed to secure antennas, steps, slide outs, or other protrusions from vehicle	0.0%	0
Other (please specify)	11.1%	3
	answered question	27
	skipped question	36

Number	Response Date	Other (please specify)	Categories
1	Sep 9, 2016 2:33 AM	N/A	
2	Sep 7, 2016 10:40 PM	Struck by another vehicle	
3	Sep 7, 2016 9:37 PM	Other vehicles have caused crashes as well	

14.

Has your department ever experienced a civilian fatality or injury requiring hospitalization due to an RV crash? (Check all that apply)		
Answer Options	**Response Percent**	**Response Count**
Fatality in a motorhome	7.4%	2
Fatality in a tow vehicle	11.1%	3
Fatality in a vehicle that struck or was struck by an RV	18.5%	5
Severe injury in a motorhome	22.2%	6
Severe injury in a tow vehicle	3.7%	1
Severe injury in a vehicle that struck or was struck by an RV	18.5%	5
None	66.7%	18
	answered question	27
	skipped question	36