DEALING WITH LIGHT RAIL EMERGENCIES IN

COOPERATION WITH DALLAS AREA RAPID TRANSIT (DART)

EXECUTIVE ANALYSIS OF FIRE SERVICE OPERATIONS IN

EMERGENCY MANAGEMENT

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ABSTRACT

The problem was the Richardson Fire Department (RFD) had no experience dealing with light rail incidents. In December 2002, Dallas Area Rapid Transit (DART) crossed the city limits into Richardson.

The purpose of this applied research project was to determine issues pertaining to emergency response and recommend training to prepare the fire department to respond to the emergency. Descriptive research was used to obtain answers to four questions:

1. What are some of the emergency response issues pertaining to passenger rail emergencies?
2. What kind of light rail emergency typically occurs in other areas DART serves?
3. What are some proactive measures DART has taken to prevent emergency incidents?
4. How should the RFD prepare for a light rail emergency in the city?

The procedures used to answer the research questions included a literature review of magazine articles, Internet searches, and personal interviews.

The results revealed the most common type of accident that could occur and identified other types of emergency incidents that occur within the DART system.

The recommendations of the applied research project are for the RFD to be aware of the most common type of accident involving a light rail train and to use DART's expertise to train members of the department.

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INTRODUCTION

The problem was the RFD had no experience dealing with light rail incidents. The first passenger train to ever cross a city of Richardson boundary had its maiden run in December of 2002 and fire department personnel had never encountered an event with the magnitude of a mass transit emergency.

While the RFD handled all types of "routine" emergency calls on a daily basis, the DART train presented a new twist to the department's mode of operation. Specifically, the train is powered by electricity (845 volts of DC current), any accident could become a mass casualty incident, and homeland security and weapons of mass destruction (WMD) issues had to be considered.

DART's light rail passenger train begins service each morning at 5 a.m. and continues every 15 minutes throughout the day until midnight. An articulating passenger train car, commonly called a light rail vehicle (LRV), with a total capacity of 160 persons, 95 feet in length, averaging 45 miles per hour, on a parallel, two-track right of way (ROW), passes through each station and across three grade crossings 75 times heading south toward Dallas and 75 times northbound (Retrieved June 17, 2004 from http://www.lightrail.com/carspecpages/ dartkispecs.htm). Incredibly, that translates to at least 150 opportunities for an accident to occur.

The purpose of this applied research project was to determine issues that pertain to emergency incident response and recommend training to prepare the fire department to respond to the emergency. Descriptive research was used to obtain answers to four questions:

1. What are some of the emergency response issues pertaining to passenger rail emergencies?
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BACKGROUND AND SIGNIFICANCE

Richardson

The city of Richardson, Texas, covers 26 square miles with a nighttime population of 96,000 (Richardson 2000). Located to the north of Dallas, Richardson has been dubbed the "Telecom Corridor" because of the unusually high number of telecom and telecommunications industries situated within its corporate boundaries.

More than 20 high-rise building dot the skyline as the large number of technical jobs provided here attract almost 150,000 people daily to work in the city. At night, the city shifts gears and settles down into a bedroom community.

Richardson is circled and dissected by three major highways: Central Expressway (Highway 75), Interstate 635, and Highway 190 on the Richardson/Plano border. These major roadways carry peak traffic three times daily and are heavily traveled on weekends.

Running parallel to Central Expressway is the recently completed DART light rail line. This rail line traverses Richardson from the southern to the northern border and continues on into Plano. Sections of the line are elevated, but there are grade crossings at three intersections inside the city limits of Richardson.

Fire Department

Twenty volunteers comprised the Richardson Fire Department in 1926. It was not until the period of 1956-63 that the city department became part-paid and volunteer. In the latter part of 1963, the department converted to a fully paid department, employing 10 persons, all former volunteers.

Today, the Richardson Fire Department (RFD) has a staff of 150 personnel, from the fire chief position to the firefighter level, operating from six fire stations. In the last five years, the department transitioned from traditional engines and trucks to utilize both Quint apparatus as well as engines and required all firefighters at the rank of private to become paramedics. This ensures that every fire apparatus is fully staffed with four personnel, two of whom must be paramedics.

The department operates four ambulances located throughout the city and an Emergency Medical Services (EMS) Lieutenant is on duty every shift. A three-platoon rotation is used to staff 46 people on each A-Shift, B-Shift, and C-Shift. Firefighters work a 56-hour week scheduled as 24 hours on-duty and 48 hours off.

Quint apparatus respond from Stations 2, 3, 4, and 5. Engine companies are housed at Stations 1 and 6. A complete rescue vehicle, equipped to handle high angle, swift water, haz mat, and confined space emergencies operates from Station 4. Firefighter/paramedics with the rank of private staff the ambulances.

Minimum staffing requirements, as outlined in the Standard Operation Guidelines (SOG), dictate four personnel on each fire apparatus, two on each ambulance, one EMS Lieutenant, and two persons on the Battalion Chief's vehicle (RFD, 2000).

The call volume of the RFD for 2003 was approximately 65% EMS and 35% fire suppression, broken down as 4,990 EMS incidents and 2,624 fire calls for a total of 7,614 responses (RFD, 2003).

DART

DART was created in 1983 when 53% of the voters in 14 cities, including Dallas County, cast 175,000 ballots favoring regional transportation. Funding came from a one-cent addition to the sales tax rate (Retrieved April 17, 2004, from, http://www.dart.org). Soon thereafter, DART assumed operational responsibility of the Dallas Transit System (DTS), which consisted of buses only. DTS did not operate any light rail service. In fact, this service was non-existent in the area.

DART staff began work on bus service improvements, rail transit, high occupancy vehicle (HOV) lanes, carpooling, and mobility-impaired transit planning. In 1984, non-stop express bus service began to member cities on the outskirts of Dallas, including Richardson.

In the last quarter of 1984, DART selected light rail as the preferred mode of transportation for their 147-mile network. To strengthen their presence in member cities, DART added additional intra-city routes to satisfy the demand of increased ridership. By 1986, buses were transporting 199,000-weekday riders system-wide (Retrieved April 20, 2004, from, http://www.dart.org/newsroommain.asp?zeon=history).

In 1988, DART purchased 34.5 miles of railroad ROW from the Southern Pacific Transport Company and began buying land to build transit stations adjacent to the rail line. Fourteen acres was purchased in Richardson in anticipation of constructing three transit centers dedicated solely to light rail. One Richardson site would also be utilized as a bus terminal.

Aware of an ever-increasing number of daily riders and permanent bus terminal locations, DART officials approved the creation of an armed transit police force to monitor crowded bus stops and respond to emergency calls. The force debuted with 25 veteran peace officers in 1989.

Richardson city officials cut the ribbon to open the city's first transit center in early 1990. The center would initially be a bus terminal with the ability to expand into a light rail stop as well.

The decade of the 1990s found DART officials implementing plans for construction of the light rail system. This included the construction of a side-by-side 3.2 mile-long tunnel underneath part of Highway 75 through a portion of the city of Dallas. In 1994, a short leg of the rail line opened for operation on the south side of Dallas.

As DART's territory expanded, demand increased on its efforts to provide adequate security. As a result, 49 more transit police were added to the force. This included, for the first time, 22 squad cars and two bicycle patrol units.

By 1996, 20 miles of rail line are in operation within Dallas' border. Exceeding all expectations, more than 18,000 passengers are using the system every day. DART reported that by the last quarter of 1997, almost 8.2 million passengers had ridden the light rail trains. By the end of 2000, total ridership throughout the system had reached 94 million people (Retrieved April 20, 2004, from, http://www.dart.org/newsroommain.asp?zeon=history).

In December 2002, DART's rail system reached 44 miles in length when Richardson became the first northern Dallas suburb to come on line. It was during this time that passengers totaled nearly 96 million trips.

Currently, the rail line ends in Plano, Richardson's neighbor to the north. Richardson and Plano share a combination bus/rail station situated on each city's border underneath Highway 190.

This research paper was compiled according to guidelines established by the National Fire Academy (NFA) in its Executive Fire Officer Program (EFOP). In Unit 2 of the course, Executive Analysis of Fire Service Operations in Emergency Management, incidents were analyzed that went beyond the capabilities of the average fire department. The student was challenged to look beyond strategy and tactics and focus on the responsibility relegated to chief officers who find themselves in charge of a large-scale incident (NFA, 2001, pp. 2-3).

LITERATURE REVIEW

The literature review for this research began at the Learning Resource Center (LRC) on the campus of the NFA in Emmitsburg, Maryland. With the assistance of the LRC staff, the author assembled published literature on the subject matter.

In addition, the author spent three hours riding on the DART light rail system accompanied by Jack Graham, DART's Manager of Rail System Safety. During this time, the author also interviewed Train Operator Steve Wilder to gain firsthand knowledge through the experience of a six-year veteran train operator.

Graham came to DART in 1992 after working in and around the transit field for 25 years. Beginning in 1970, he supervised the construction of the first 300 LRVs shipped to Washington D.C. and spent six months there placing those cars in service. He also spent time at the research center operated by the federal government in Pueblo, Colorado, testing rail cars.

In 1981, he went to Houston to oversee their plan to operate a heavy rail system, which utilized a third rail for electrical current. However, the voters rejected the bond issue and Graham left for Los Angeles to supervise their red line project.

Graham returned to Houston when the city was successful on the second attempt at a bond election and voters this time approved a light rail system. He left Houston for good when transit managers rejected recommendations from the Houston Fire Department (HFD) and city officials to adopt the guidelines of National Fire Protection Association (NFPA) 130, *Standard for Fixed Guideway Transit and Passenger Rail Systems*. Graham recognized design flaws, inadequate signage, and a lack of safety equipment in Houston's system. Its managers clearly objected to NFPA 130.

Additionally, the author reviewed brochures and pamphlets written by DART personnel for use by outside emergency responders, enabling them to better understand the peculiarities of dealing with an emergency involving the light rail system. A brochure that contains helpful information for firefighters is appropriately titled *LRT Safety Awareness—Fire Department Training Manual*.

DART has a written set of guidelines, entitled *Light Rail System Book of Operating Rules*, that details the responsibility of each segment of its workforce in the event of any type of emergency. This manual is distributed to every DART employee and is required reading for all job assignments.

Demographic and light rail system information was accessed through the Internet and DART's website was very useful. Another informative website dealing with transit accidents nationwide, austinatrain.com, provided much of the statistical information for this paper.

The website mentioned above contains a study done by the Transportation Research Board (TRB) which focuses on the causes of accidents at light rail crossings. The Austin Monorail Project (2003) lists some of the most common safety-related problems as:

- Motorists driving around lowered automatic gates;
- LRV operators unable to confirm that flashing lights and gates are functioning at grade crossings due to line of sight problems;
- People who use crossings are confused about fast-moving LRVs in relation to slower freight trains;
- Pedestrians dart across the tracks without looking both ways;
- Pedestrians trespass along the ROW;
- Motorists become confused when automatic gates are raised and then lowered shortly thereafter, unaware a train is coming from the opposite direction (p. 1).

DART employee Dan Rucker, a Rail Safety Specialist responsible for much of the material contained in *LRT Safety Awareness—Fire Department Training Manual*, said most of the problems encountered by DART could be averted if safety was practiced on and about the ROW by all personnel (D. Rucker, personal communication, May 8, 2004).

Nationwide, rail transportation systems are governed by the NFPA 130. Bruce Arvizu, a captain with the Los Angeles County Fire Department, wrote about commuter trains in Southern California. Arvizu (1993) said NFPA 130 identifies specifics of fire protection and suppression systems for railroad equipment and places of business (p. 19). He adds that information contained in the NFPA document provides a framework for safety in many aspects of the passenger rail industry.

The 2000 edition of NFPA 130 (NFPA, 2003) specifically addresses fixed guideway transit and passenger rail systems with changes made throughout the document to incorporate passenger rail requirements (p. 2).

Graham said DART is very aware of the guidelines established in NFPA 130 and not only adheres to that standard, but strives to surpass the minimum requirements whenever possible (J. Graham, personal communication, April 20, 2004). According to Graham, most of the emergency response issues DART experiences are caused by human error on the part of the passenger and not DART employees. "People just don't pay attention to the trains, regardless of how many signs we post or the bells and whistles we use" (Graham, 2004).

Mass casualty incidents certainly come to mind when considering any incident dealing with a passenger train. An attitude of complacency while driving around light rail corridors can be fatal. In 1997, in the United States alone, there were 3,765 collisions, resulting in 445 fatalities and 1,458 injuries (Cunliffe, 1999).

The author also reviewed the guideline provided by the Dallas Fire Department (DFD) written expressly for dealing with DART emergencies. Dallas Deputy Chief Brian Williams is the chief officer in charge of DFD training as it relates to DART and serves as liaison between the two organizations.

Chief Williams said it has been their experience that the majority of emergency calls requiring the response of the DFD have been at grade crossings where vehicle traffic ignored operating warning devices. Emergency medical calls on a DART train are not a serious problem since the ambulance is dispatched to the next train station. Calls are seldom answered to a train halted between stops.

Cunliffe (1999) said transit agencies should concentrate on the safety of grade crossings and not rely on the assumption of absolute right-of-way for rail traffic (p. 24).

Chief Williams (2004) believes DART, although it is a large, complicated organization, operates extremely well in the safety category except when citizens disregard all devices specifically in place to protect them (B. Williams, personal communication, April 24, 2004).

Other transit agencies across the U.S. have had similar experiences. Vigh and Loomis (2000) said the American Public Transit Association (APTA) reported transit systems average 15 accidents each year, but most are not fatal. Transit officials say pedestrians trespass on the tracks, unaware of the presence of approaching trains (Retrieved June 2, 2004, from, http:// www.austinmonorail.com/light_rail_vs.htm).

Mike Wiley (2001), an official with the Sacramento Regional Transit District, said Sacramento's transit system does have accidents, but "the design of the rail system" has not been found at fault in any of them. Instead, "they basically involve a motorist who made an illegal movement" (Retrieved May 31, 2004, from, http://www.austinmonorail.com/light_rail_vs.htm).

The author also contacted Operations Chief Bob Acker of the Plano Fire Department (PFD) and Assistant Chief Raymond Knight of the Garland Fire Department (GFD). Neither department has any written policy on dealing with DART even though the rail line extends into their respective cities (B. Acker, R. Knight, personal communication, April 26, 2004).

PROCEDURES

At the LRC in Emmitsburg, MD, a preliminary on-line literary search was conducted for existing material regarding transit systems.

The DFD Deputy Chief assigned as the DART liaison was interviewed since that department has been involved with DART from the very beginning, going back to the early 1980s. The executive staff of the DFD, through its training section, wrote an emergency procedures guideline specifically for dealing with DART incidents, ranging from fire emergencies, EMS calls, to hazardous materials incidents in proximity to rail line.

Other fire department contacts made included the Assistant Chief of Administration for the Garland, Texas Fire Department (GFD) and the Division Chief of Operations for the Plano, Texas, Fire Department (PFD).

In April 2004, extensive interviews were conducted with Jack Graham, who serves as DART's Manager of Rail System Safety. Graham has 25 years experience in the transit field and has worked for DART since 1992. Graham and his team of safety specialists are responsible for much of the proactive improvements throughout the DART organization to ensure compliance with NFPA 130.

Then in May, the author spent three hours riding in the cab of a DART train with Train Operator Steve Wilder. Wilder explained signage and signaling along the track and the training an operator undergoes before being entrusted with the throttle of a passenger train.

As research continued, Graham and the author met on several separate occasions in May and June as responses were needed to answer the research questions. These meetings took place in DART train and bus terminals as well as on the train itself in order to be able to "see" what the answers were instead of using telephone communications.

DART's manuals, both the *Light Rail System Book of Operating Rules* and the *LRT Safety Awareness—Fire Department Training Manual* were reviewed since the organization has

done its own extensive research into what it is that makes a transit system successful and safe. Periodicals were also reviewed.

In addition, U.S. Departments of Transportation and Commerce as well as Federal Emergency Management Agency (FEMA) manuals were used to reference guidelines for hazard analysis and emergency preparedness. The Internet was accessed for information pertaining to city of Richardson demographics, Bay Area Rapid Transit (BART), and DART's history.

Definitions found in various plans reviewed for this paper are included.

Definitions

- DART—Dallas Area Rapid Transit.
- LRV—light rail vehicle.
- ROW—right-of-way.
- Catenary—overhead electrical wires delivering 845 DC volts of primary power to a rail car.
- Pantograph—a V-shaped carriage assembly mounted above a rail car that can be raised or lowered to make electrical contact with a catenary line.
- BART—Bay Area Rapid Transit.

RESULTS

Research Question 1. What are some of the emergency response issues pertaining to passenger rail emergencies?

One of the greatest concerns regarding light rail is the possibility of an accident that would involve mass casualties. DART trains travel at speeds ranging from 20 miles per hour (mph) to 65 mph. Cunliffe (1999) said this speed range places DART in the moderate-speed

category. He noted that the high-speed range reaches 124 mph and the very-high-speed range is any speed above 125 mph (p. 24).

The Metro Transit Authority (MTA) in Los Angeles is trying to shed the distinction of being one of the deadliest light rail systems in California. The MTA has installed a fiber optic sign over a walkway that has been the scene of 16 accidents, including four deaths. None of these incidents transitioned into a mass casualty situation.

Shuit (2001) wrote that the sign cost $200,000 and the MTA places blame for the accidents on motorists and pedestrians who walk or drive against signals (Retrieved May 31, 2004, from, http://www.austinmonorail.com/light_rail_vs.htm).

In the city of Richardson, only about 40% of the track is elevated. Elevated portions are used to cross high-traffic intersections that were already in use before DART was organized as a rail system. Graham (2004) said the DART train would likely de-rail at a switching point (where trains are manually diverted to another track). Fortunately, there are only two manual switches in Richardson and both are located on flat ground.

Further, DART rules (2001) mandate that a train entering a manual switching location must slow to speeds ranging from 10 mph-20 mph (p. 66). At this low rate of speed, the impact of a derailment would be minimal, thereby lessening the chance of a mass casualty incident if the train were to leave the track.

Graham (2004) and Chief Williams (2004) both agree that the collisions that have occurred at grade crossings were not mass casualty incidents. The weight of a 110,000-pound LRV, along with its forward velocity, nullified the impact a collision with a vehicle had on the passengers riding the train.

The issue of gaining access to a disabled LRV on an elevated portion of the track does pose a problem for the RFD. In most cases, especially in Richardson, aerial apparatus can be positioned to reach the track area. DART averted part of the problem when the track beds were laid. Since land restrictions were not a concern when ROW and easements were platted, the track bed was widened a few feet on each side of the track. This "walkway" allows for passengers to exit the LRV and walk down the elevated portion. Likewise, it allows firefighters to walk up as well.

Clearly, in the event of an arson fire, bombing, or terrorist act that occurred on an elevated portion of the track or in another remote area, firefighters would have a difficult time gaining access to and removing victims. Logistically, the city of Richardson does not have a location that would pose a significant problem of access.

The danger of electric shock is a significant hazard when working around an energized LRV. DART trains are powered by 847 volts of DC power running through a catenary wire above the track bed. The pantograph is a V-shaped device attached to the roof of the LRV that, when in contact with the catenary, provides power to operate the train (DART, 1999),

Firefighters or other rescue personnel have to be trained how to de-energize the train and shut the power off. Otherwise, if a firefighter were grounded and touched a charged area of the LRV, he would be electrocuted. The DART dispatch center can disengage the power supply remotely. In addition, firefighters can be taught how to lower the pantograph, thereby shutting down the train's power supply.

Research Question 2. What kind of light rail emergency typically occurs in other areas DART serves?

DFD's DART Emergency Procedures (2004) lists the following types of emergency responses their department may encounter:

- Fire emergencies inside the DART tunnel;
- Fire emergencies outside of the tunnel;
- EMS emergencies;
- Responding to emergencies in the Transit Mall or Transit Corridor; and
- Hazardous material spills next to the ROW (pp. 157-182).

Chief Williams maintains the primary concern of the DFD is an accident occurring at a grade crossing in a train versus automobile scenario. In 2003, three persons were killed in separate accidents when automobiles ran through operational crossing arms and collided with a train.

DART records (2003) indicate that as of August 2003, 17 vehicle/train collisions had been reported with the fatal incidents noted above (p. 1).

Cunliff (1999) certainly agrees since he advocates the total elimination of grade crossings completely. He has proposed that overpasses and underpasses be provided instead of grade crossings because the current system is straight from the "horse and buggy" era since modern-day trains run at such high speeds (p. 25).

Neither the DFD nor any other agency contacted for this research paper reported any problem on DART's rail system involving fire on a train. While it could occur, Graham (2004) maintains that strict adherence to NFPA 130 has assisted DART's effort because this standard contains guidelines for rail car passenger safety and includes annexes for fire safety hazard analysis for the entire transit system.

LRVs utilized by DART cost around $2.7 million each. The bottom of the car must pass a fire-rating test of 30 minutes. Graham (2004) said DART and the city of Dallas agreed in 1987 that NFPA 130 would be standard used in every aspect of DART safety compliance, including the placement of fire hydrants, fire lanes, and flammability ratings.

Chapter four of the current edition of NFPA 130 (2003) says one of its goals is to provide an environment for occupants of fixed guideway and passenger rail system elements that is safe from fire and able to maximize the survivability of occupants intimate with the initial fire development (p. 17).

An issue that has gained national attention in the recent past is the possibility of transit terrorism. The Transit Cooperative Research Program, under the umbrella of the United States Department of Commerce, funded a study on this topic and mentioned the 1995 derailment of Amtrak's Sunset Limited in Arizona, several New York City subway fire bombings, and a shooting on the Long Island Rail Road. More recently, a passenger train in Spain was the target of terrorist bombing.

In the study, Boyd and Sullivan (1997) said it was the aim of terrorists to disrupt the transit system and attempt to inflict heavy casualties (p. 14). Most of the transit targets have been in European countries and Japan where hundreds of thousands of persons rely on mass transit on a daily basis.

William Millar (2004), the president of the American Public Transportation Association (APTA), stated that because safety and security is the top priority of the public transportation industry, $1.7 billion has been spent to fund security initiatives. He continued by saying that APTA was working closely with the office of Homeland Security to ensure the safety of

America's public transportation riders (Retrieved May 10, 2004, from, http://www.apta.com/ media/releases/require_funding.cfm).

While transit terrorism cannot be overlooked for this paper, an emergency response of this nature would begin as a police matter and quickly transition into an EMS mass casualty and/or fire situation. A joint operation between police and fire would be established to mitigate this type of incident.

Homeland security is a high priority issue within the DART organization. One of the primary concerns expressed by Graham were the problems caused by passengers attempting to simulate a real emergency. Passengers often leave baggage on the train that would, under normal situations, be considered trash and discarded.

However, DART employees, including transit police, activate emergency procedures to determine the contents of unclaimed packages. This has caused an expenditure of time and energy and resulted in trains being delayed and passengers inconvenienced (Graham, 2004).

The DART train line currently ends north of Richardson in the city of Plano, Texas. Even though the train has been running this route for two years, Chief Acker (2004) said he could not recall any incidents involving DART, unless it was an EMS call at the transit station. Further, he stated that the PFD did not have a written procedure for dealing with any DART emergency incident (B. Acker, personal communication, April 26, 2004).

Likewise, DART has recently opened a line into the city of Garland, Texas. According to Chief Knight (2004), the GFD uses established SOGs to handle DART incidents and no plans are being made to write a specific guideline (R. Knight, personal communication, April 26, 2004).

If a grass fire were to occur on the DART ROW, Chief Williams (2004) said DART would notify DFD through the 9-1-1-telephone system. DART would halt train service to the

area when the fire department arrived and immediately resume when the Incident Commander (IC) radioed fire dispatch the fire was out. Fortunately, DART frequently maintains ROWs and grass fires are a rare occurrence.

Research Question 3. What are some proactive measures DART has taken to prevent emergency incidents?

In the introduction of DART's Operating Rules (2001), it states

> Safety must always be the first consideration. The result of unsafe practices on the rail system can be extremely serious. All employees are required to exercise care to prevent injury to persons or damage to property. Employees in doubt or uncertain in any situation must take the safe course of action and then contact the designated authority. (p. 1)

Graham (2004) said DART did not decide to operate a transit system and then decide to do it safely. Instead, officials wanted to know what some of the safety issues and problems were before getting started and researched methods used by experienced transit systems.

DART officials traveled around the country and studied transit systems that were already in operation to implement what worked best and tried to avoid pitfalls and problems experienced by other organizations. Site cities reviewed were Houston, Chicago, San Francisco, and Washington, D.C. In short order, DART has become the national poster child for light rail (Richelieu, 2000).

NFPA 130 plays an important role in train safety since the BART tunnel incident in San Francisco in 1979 in which a firefighter was killed. As a result, BART launched a $40 million fire hardening campaign to examine the material makeup of the LRV.

Ultimately, BART installed a stronger firewall in the floors of the rail cars and changed all the seats to a material that was fire-resistive. Their research became a foundation for changes in transit systems nationwide (Retrieved May 31, 2004, from, http://www.cnn.com/ TRANSCRIPTS/0302/22/nac.00.html).

For its LRVs, DART developed a light rail vehicle safety certification checklist to be used in the design, construction, and testing phase before a rail car is purchased. The checklist contains 205 separate items for inspection. Every item must pass or the LRV is not certified.

Internally, DART has developed its *Light Rail System Book of Operating Rules*. Adopted in September 2001, this guide is mandatory reading material for all light rail employees, whether it be train operators, service people, track maintenance personnel, or mechanics. Many employees keep the manual within easy reach for quick reference.

Operating rules cover a wide variety of subjects, such as:

- Application of Rules;
- Courtesy and Conduct;
- Care/protection of Property and General Safety;
- Employees on or About the Track;
- Accident and Emergencies;
- Medical Assistance;
- Informing Passengers;
- General Signal Rules;
- Wayside Signs;
- Train Operator Responsibility;
- Coupling and Uncoupling;

- Yard Movement and Storage;
- Speed;
- Sight Operation; and
- Protection of Personnel on Tracks and/or Removal of Power Authorization.

While riding in the cab of the DART train, the author witnessed some of the safety measures DART has in place to proactively reduce accidents and ensure safety. Some examples are:

- Hand signal indications— while working in proximity to the tracks, every DART employee or contractor must use hand signals to indicate they see the train approaching; the train operator will sound the horn or gong if a worker fails to signal; if no signal is received, the train will stop;
- All trains have horns, gongs, and whistles with rules for sounding each device; in limited visibility situations, strobe lights are also used;
- As a part of the Operating Rules, all employees are charged with protecting DART passengers and property in times of accident or emergency;
- In areas where the trains parallels a street, it is possible for traffic to turn left across the track; DART has installed large, lighted, flashing signs that flash "TRAIN COMING" to oncoming traffic;
- Traffic signal lights on the roadway are timed to coincide with the passing of the train;
- Grade crossing warning arms are lowered at least 20 seconds before the train approaches; the train operator must still visually see that the gate protection is working or the operator is required to immediately stop the train;

- Trains operate at restricted speeds through school zones;
- When departing any station, the train operator must visually see that all doorways are clear of passengers; if passengers linger, gongs are sounded; trains are never put in motion until the doorways are cleared;
- Train Operator Wilder (2004) stated train operators are trained for a minimum of eight weeks; supervisors ride along for another two weeks; supervisors must operate a train for one hour each month on the line they supervise as part of continuing education (S. Wilder, personal communication, April 29, 2004);
- Train operators must apply continuous pressure to the operating throttle; otherwise, after a 10-second delay, the train will shut down and slow to a stop; this precaution is in place in the case where the operator would be disabled, due to heart attack, hijacking, etc.

DART's safety initiatives seem to be paying dividends. In Budget Year 2003, the accident rate per 100,000 miles operated had a yearly average of only 0.33. Through April of 2004, that number had been reduced to 0.29. Safety engineers had set a goal of 0.56 (DART, 2004).

DART conducts a monthly safety meeting, called the Fire/Life Safety Committee, to discuss current situations, to address past problems, to evaluate the events of the past month, and update members on upcoming activities. Included in this meeting are representatives of all Dallas-area agencies who choose to participate. The body is composed of directors of all major DART operations, members of the DFD, the Fire Marshal's office of the DFD, Dallas County, the city of Dallas, the Dallas Police Department, and a representative of any DART-member city.

In cooperation with the DFD, DART conducts quarterly drills and training exercises in various fire districts. Dallas fire training officers and DART safety specialists design scenarios and schedule fire companies to participate. This is particularly important around the 3.2-mile tunnel district.

In addition, DART conducted training evolutions with individual fire departments in cities where the rail line was extended. This included the cities of Richardson, Plano, and Garland. Graham (2004) said training was specifically geared to gaining access and egress of LRVs, disengaging the pantograph from the electrical system and turning off the power, and other aspects of rail safety.

Finally, DART attempts to maintain a dialogue with its service cities. They invite participation in their safety meetings and reserve seats on their committees. Safety specialists and engineers will make off-site visits upon request. DART has made it clear they want to assist area fire departments in any way possible to proactively mitigate an incident.

Research Question 4. How should the RFD prepare for a light rail emergency incident in the city?

Safety planning should be a primary consideration, both for preventing the occurrence of the incident and having the capability to react when an accident does occur.

An emergency plan should be developed to include the following topics:

- Dispatching the appropriate emergency response to the scene;
- Evaluating and establishing the parameters of the emergency;
- Coordinating inter-organizational agreements;
- Determining DART's scope of function and responsibility;
- Emergency procedures and priorities;

- Extended operations;
- Logistical concerns;
- Winding down the operation.

A FEMA report notes that rail incident responses are generally long-term in nature and require considerable resources, such as food, fuel, shelter, lighting, and communications, especially when a remote location is involved (Kimball, Stambaugh, 2003).

The RFD should expect a light rail emergency incident to last longer than an average structure fire situation. After the initial response, 80% of personnel will be expended. Off duty members will need to be notified quickly and given instructions on where to respond.

Listing of phone numbers and contact information for supplies should be assembled. Likely, the incident could result in the establishment of a unified command. Information on all parties that could respond should be gathered into one place for quick reference.

Adduci, Hathaway, and Meadows (2000) recommend a hazard identification and resolution process to include identifying the hazards that exist, determining their cause, assessing the hazards for severity, probability, and determining how much risk to accept, and then deciding the best corrective action to implement (p. 4).

Since fire departments know and understand the benefits of pre-fire planning for a structure, it would also be beneficial to conduct a joint training exercise with DART personnel. Initially, simple scenarios could be devised and then transition into more complex situations as fire companies gained more knowledge and experience in this area.

RFD's training section officer should rely on the experience and expertise of Jack Graham to gain insight into particular areas where training could be focused and developed.

Since DFD already has a track record of successful training evolutions with DART, their guidance could be a useful tool as well.

Since a large incident would quickly expend RFD's resources, mutual aid plans and procedures would need to be updated and expanded. It is conceivable to exhaust every RFD station and on-duty member in a sizable incident. Mutual aid agreements may not address backfilling stations or responding personnel to the scene for an incident that may continue for extended hours or even days.

DISCUSSION

Before December 2002, the RFD had never experienced light rail traversing the city of Richardson. Proactively, fire department managers could have taken the lead of the DFD by beginning to plan and train for the possibility of emergency incidents involving DART.

Instead, the fire department, by its inattentiveness to this issue, must now be reactive to the fact that the 9-1-1 call will go directly to the dispatch center and then out to the fire station. Unfortunately, the battalion chief and station officer on duty that day cannot refuse to answer the alarm because of a lack of training.

It is the duty of fire department managers to provide personnel with the tools necessary to mitigate a call for assistance from DART, whether it is a routine EMS call, a fire or derailment, or a mass casualty situation.

The level terrain and wide ROWs through Richardson is a huge plus for the fire department. This eliminates the need to plan for crossing bridge trestles with firefighting equipment and apparatus or having to place equipment on two sides of a creek and manage two

distinct operations. Similarly, the elevated portions are in close proximity to roadways, providing a solid, stable surface for aerial ladder placement.

Grade crossings are one of the main concerns for the RFD. Cunliffe (1999) says DART trains traveling from 20 mph to 60 mph are in the moderate-speed category (p. 25). Graham (2004) and Chief Williams (2004) both agree that it has been their experience that grade crossing accidents do not typically transition into a mass casualty incident. The forward velocity and 110,000-pound weight of the LRV simply overpowers an automobile.

The Austin Monorail Project (2003) study points out the following problems:

- Motorists driving around lowered automatic gates;
- LRV operators unable to confirm that flashing lights and gates are functioning at grade crossings;
- People who use crossings are confused about fast-moving LRVs in relation to slower freight trains;
- Pedestrians dart across the tracks without looking both ways;
- Pedestrians trespass along the ROW;
- Motorists become confused when automatic gates are raised and then lowered shortly thereafter, unaware a train is coming from the opposite direction (p. 1).

DART records (2003) indicate that as of August 2003, 17 vehicle/train collisions were reported, of which only three were fatalities (p. 1).

Cunliff (1999) advocates the total elimination of grade crossings altogether. He has proposed that overpasses and underpasses be provided instead of grade crossings because the current system is straight from the “horse and buggy” era since modern-day trains run at such high speeds (p. 25).

Strict compliance with NFPA 130 on the design of rail cars has nullified the danger of the LRV catching fire, especially from underneath. Terrorist activity could still pose a threat, but Richardson's outdoor transit stations and remote locations do not lend itself to this situation because the emotional impact would not reach the terrorists' satisfaction level. While killing or maiming 160 people would be a devastating blow to individual families, the DART tunnel or Union Station, both located in Dallas, would cause a much greater business and emotional disruption and command more national exposure.

Another significant concern to RFD is the fact the train is powered by 845 DC volts. Firefighters responding to an emergency often have the tendency to be narrowly focused, primarily on the incident itself. A methodical, deliberate approach to any emergency incident on the DART ROW should be heavily emphasized.

Clearly, DART has done its homework in the area of safety. Some examples are strictly adhering to NFPA 130, writing a set of operating rules, preparing safety manuals for first responders, formulating the checklist for LRVs, proactive signage and signaling, safety meetings and training sessions (internal and external), and an organizational diligence to ensure the safety of the passengers they transport.

Before December 2002, RFD personnel did spend time looking at an LRV and DART personnel conducted a training class. Since that time, no follow-up training has occurred. Also, fire department personnel have moved to other positions. Others have replaced company officers and members who attended the initial training classes. RFD has not written a policy or procedure that specifically deals with DART.

Logistically, level surfaces have not been identified where aerial apparatus could be positioned for the elevated portions of the rail line. No thought has been given as to what

equipment a company might "walk" to a stranded/disabled LRV in the event of a fire or EMS situation.

Training evolutions have not been coordinated through DART's safety team nor has any RFD member been a part of any DFD exercise.

RECOMMENDATIONS

The research indicates the following recommendations:

- Accidents at grade crossings are a nationwide problem—

  DART's history and the history of other U.S. transit systems, coupled with the experience of the DFD, suggests that a grade crossing incident where a LRV collides with an automobile would be the incident most likely to occur in Richardson. Although the train would be involved, this incident would mainly focus on EMS and rescue. The RFD is familiar with this type of response. However, the presence of an energized LRV would have to be mitigated before any other operation could occur.

- Take advantage of DART's training expertise—

  RFD, through its training section, should contact DART's safety section and begin to develop internal and external training exercises that focus on all aspects of the rail system. As knowledge is gained, the training could narrow to specifically target the intricacies of LRVs. The first item learned should be how to disable the power supply to the LRV. DART's Graham has offered his expertise to the RFD and has extended the full cooperation of his safety specialist staff to assist in training exercises and drills.

- □ Pre-plan RFD's response—

  RFD training should also center on the logistical concerns of the rail line itself. Locations need to be identified that are conducive to aerial operations and remote areas should be mapped so accessibility could be gained quickly. Equipment and supply lists should be formulated so only the most necessary items are hand-carried.

- □ Write operating procedures and guidelines, specific to DART—
  - Initial response;
  - Resources;
  - Calling in off-duty personnel;
  - Rehab;
  - DART contact information.
- □ Ensure the availability of mutual aid through current agreements;
- □ Ride the train and observe how it operates.

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