An Analysis of the effect on Marin County Fire Department due to the re-introduction of rail service in Marin County

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CERTIFICATION STATEMENT

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, or writings of another.

Signed:____________________________
Abstract

The purpose of this research is to conduct an analysis on the effects of the re-introduction of passenger and freight rail service in Marin County on the Marin County Fire Department (MCFD). The MCFD is an all risk agency that provides a full range of emergency response services including Emergency Medical Services (EMS), Urban Search and Rescue (USAR) and water rescue teams, structural and wildland fire protection, fire prevention, public education, and hazardous material discharge response. The problem is that MCFD has no experience responding to rail related incidents, nor has there been any evaluation of the implications with regards to fire and life safety with the re-introduction of this service.

Descriptive research methodology was used to answer the following questions: 1) What are assets and critical infrastructure at risk? 2) What are the potential events associated with rail service with which the Marin County Fire Department will be expected to contend? 3) Given the results of question (2), what are the Marin County Fire Department's equipment and personnel needs to address these incidents? 4) What are the mitigating measures that may be taken to reduce the impact of the incidents that may occur?

The results of this research indicated that the fires most associated with rail operations are loosely defined as “equipment failures” and occur external to the cars themselves. No fire history involving the interior of rail consists and cars, themselves was found. The main threat to life safety represented by the reintroduction of rail traffic in Marin County is that of rail collisions with automobile traffic at the 20 grade crossings within Marin County. Other threats that will affect MCFD include wildland fires caused by the aforementioned “equipment failures” due to rail traffic in the State Responsibility Areas (SRA), for which MCFD has primary responsibility within Marin County.
Table of Contents

Abstract ........................................................................................................................................... 3
Table of Contents .......................................................................................................................... 4
Introduction .................................................................................................................................... 5
Background and Significance ......................................................................................................... 6
Literature Review .......................................................................................................................... 9
Procedures ..................................................................................................................................... 23
Results ........................................................................................................................................... 25
Discussion ..................................................................................................................................... 30
Recommendations .......................................................................................................................... 42
References ....................................................................................................................................... 46

Appendices

Appendix A .................................................................................................................................... 50
Appendix B ....................................................................................................................................... 58
Introduction

This year, the San Francisco Bay Area and the State of California are celebrating the 75th anniversary of the opening of the Golden Gate Bridge. The bridge connects northern San Francisco to the southern tip of Marin County. Prior to the opening of the bridge, Marin County had a predominately rural economy of timber production and dairy ranching, the products of which were transported to San Francisco via rail and ferries to San Francisco.

After the opening of the bridge, Marin County and subsequently Sonoma County (with which Marin County shares its northern border) slowly transitioned into bedroom communities/suburbs of San Francisco. As such, south-bound passenger automobile traffic across the Golden Gate Bridge increased from 11,045 average trips per day in the first full year of operation (1937-38) to a peak of 120,276 vehicles per day in 1989-90, with last year’s (2010-11) traffic at 110,113 vehicles per day making the south-bound crossing (http://goldengatebridge.org/research/crossings_revenues.php). This increase in traffic ironically prompted the bridge’s owners (the Golden Gate Transportation District) to initiate ferry (1970) and bus service (1972) from Marin and Sonoma Counties in order to mitigate traffic congestion on the bridge and its approaches (http://goldengatebridge.org/researchlibrary/history.php).

However, as Marin and in particular Sonoma County grew in population, traffic concerns (specifically commute traffic on Highway 101) year after year consistently polled as the most pressing concern of the voting population. In response to this concern, the Sonoma Marin Area Rail Transit District (SMART) was created by the state legislature (Assembly Bill 2224) in 2003 to construct a passenger rail system from Cloverdale (Sonoma County) to Larkspur (the site of the Golden Gate Ferry terminal). A bond measure was placed on the ballot in 2006 impose a 1/4 cent sales tax on Sonoma and Marin to construct this system. This initial measure failed to
garner the require 2/3 majority of votes to pass. A subsequent measure was placed on the ballot in 2008, passing with the requisite 2/3 majority ("What is SMART?," n.d., p. 1). With the passage of this measure, passenger and freight rail service is being reintroduced to Marin County after a 53-year absence (in the case of passenger rail). The problem is that no evaluation of the implications with regards to fire and life safety with the reintroduction of this service has been conducted.

The purpose of this research is to provide the Chief of the Marin County Fire Department with an analysis of the implications of what the re-introduction of both passenger and freight rail traffic will have on the department. A descriptive research methodology was used to answer the following questions: What are assets and critical infrastructure at risk? What are the potential events associated with rail service with which the Marin County Fire Department will be expected to contend? Given the results of the second question, what are the Marin County Fire Department's equipment and personnel needs to address these incidents? Finally, what are the mitigating measures that may be taken to reduce the impact of the incidents that may occur?

Background and Significance

After the construction of the Golden Gate Bridge, and the subsequent diminution of rail services with Marin County, the north-south Northwestern Pacific (NWP) rail right-of-way, which parallels Highway 101 (the main north-south highway in Marin County; Appendix A, Figure 1) continued to provide passenger and freight rail traffic, finally ceasing in 1959 and 1985, respectively (Fred Codoni, personal communication, July 11, 2012).

Population growth in both Marin and Sonoma counties prompted several flirtations with re-initiating commuter passenger rail traffic in Marin County. The first such initiative was an effort in the late 1950’s and early 1960’s to participate in the Bay Area Rapid Transit System
Although Marin County voters overwhelmingly supported participation, in 1962 BART officials requested that the Marin County Board of Supervisors withdraw from the District, fearing that Marin County’s small tax base was inadequate to support their projected share of the costs. Other factors prompting Marin County’s withdrawal was the Golden Gate Bridge District’s opposition to constructing a lower deck across the bridge for BART trains ("Did Marin lose out on BART?," 2010, p. 1). Other initiatives to improve transportation across the bay from San Francisco into the north-bay counties, including the construction of an additional bridge connecting San Francisco to Marin at Tiburon via Angel Island were still-born due to Marin County’s fears of the development of urban sprawl and un-fettered population growth.

The Marin County Fire Department evolved from the Tamalpais Forest Fire Protection District (TFFPD), which was created by an act of the State legislature in 1917. The genesis of the TFFPD was to protect the district’s assets, predominately timber, from wildland fires. Original boundaries of the district can be found in California Senate Bill 555, Chapter 560 of May 21, 1917 (Alber & Roberts, 2008, p. 1-1). In the years to come, the district boundaries were expanded several times and, eventually, encompassed over two hundred and fifty seven square miles of land area. The Marin County Fire Department was created by the Marin County Board of Supervisors in 1941 (Alber & Roberts, 2008, p. 1-1).

The Marin County Fire Department is an all risk agency that provides a full range of emergency response services including Emergency Medical Services (EMS), Urban Search and Rescue (USAR) and water rescue teams, structural and wildland fire protection, fire prevention, public education, and hazardous material discharge response. As one of six contract counties with the State of California Department of Forestry and Fire Protection (CALFIRE), the
department is responsible for the wildland fire suppression and investigation of 205,000 acres of State Responsibility Area (SRA) within the county. MCFD’s contract also includes the responsibility of preparing and annually updating a Community Wildfire Protection Program (CWPP) for Marin County, and managing and enforcing vegetation management and defensible space regulations in Marin County SRA.

MCFD’s contract with CALFIRE makes MCFD the preeminent wildfire agency in Marin County. This is because the contract specifies that MCFD has primary responsibility for suppression of wildfires in the county’s SRA, regardless of jurisdictional boundaries. The contract also enables MCFD to access CALFIRE resources directly (and in particular fixed and rotary winged fire suppression aircraft) for any wildfire in or threatening the county’s SRA.

In addition to MCFD, there are twelve additional fire agencies within Marin County (three of which are staffed with volunteers and a paid/full-time Chief). Although the planned route of the rail service travels through only four of these agencies’ respective jurisdictions (Novato Fire District, MCFD, San Rafael Fire Department, and Larkspur Fire Department, Appendix A, Figure 1), the limited staffing of the Marin County fire service as a whole has prompted the formation of a county-wide master mutual-aid agreement. Furthermore, approximately 17 miles of the rail line travels through SRA (or within ½-mile of SRA) for which MCFD has primary wildland fire suppression responsibility (Figure 3, Appendix A). As such MCFD, through its SRA responsibilities, or through mutual aid agreements, may be called to respond to a wide spectrum of incidents involving this new rail service.

This applied research project is consistent with at least four of the five United States Fire Administration’s operational objectives in that by evaluating the impact on MCFD of rail traffic in Marin County, MCFD will inevitably reduce the damage caused by incidents involving
passenger and freight rail traffic, while also providing for a safer working environment for MCFD’s firefighters, thereby reducing the potential for loss of life. This will in turn reduce the loss of life from fire in the age group 14 years old and below and in the age group 65 years old and above, of which Marin County has a significant and growing population (United States Census Bureau, American Fact-Finder, 2010). This project will also help MCFD to respond appropriately and in a timely manner to this emerging threat (National Fire Academy [NFA], 2008, p. II-2).

Additionally, this research is related to the lessons and objectives of the Executive Fire Officer Program’s 3rd year course, Executive Analysis of Fire Service Operations in Emergency Management (R-306). These lessons included risk assessment, fire service capability assessment, emergency operations, and the Integrated Emergency Management System (IEMS) (National Fire Academy [NFA], 2012, p. I-5). All of the aforementioned lessons will be brought to bear in adopting the recommendations of this research paper.

**Literature Review**

From its very beginning, MCFD’s roots have always been focused on wildland fires. From their beginnings as TFFPD, where the main issue was protecting timber assets from destruction by wildland fires, to the present day where the assets MCFD protects include economic assets in the form of the tourist attractions, residential communities, watershed lands, as well as endangered plant and animal habitat. However, as a result of the increasing urbanization of portions of MCFD’s jurisdiction as well as the county as a whole, and the collapse of the timber industry, MCFD has been compelled to become an “all-risk” fire agency, offering EMS, Urban-Search and Rescue, Hazardous Material release response, in addition to the
traditional fire response. The re-introduction of rail traffic in Marin County after a prolonged absence represents just one more aspect of emergency response for which MCFD must contend.

A literature review was conducted, focusing on the five research questions: 1) What are assets and critical infrastructure at risk? 2) What are the potential events associated with rail service with which the Marin County Fire Department will be expected to contend? 3) Given the results of question (2), what are the Marin County Fire Department's equipment and personnel needs to address these incidents? 4) What are the mitigating measures that may be taken to reduce the impact of the incidents that may occur?

The National Fire Protection Association (NFPA) is a private organization that uses the consensus process; i.e., government, academia and private industry constitute the voting and standard committee members, to promulgate model codes and standards. Although these standards in and of themselves do not have the force of law, they are at a minimum “best practice” documents, and as such are often referenced and/or adopted by the Federal Government when the subject of the respective code or standard cuts across state lines or is of national concern. For example, NFPA 101, The Life Safety Code, applies to all Federal buildings. It is common for state and local governments to adopt many standards developed by NFPA as part of their local adoption and amendment of the model codes. If a particular standard or code developed by NFPA is adopted as part of a government’s code, then the standard adopted does have the force of law.

One NFPA standard is directly applicable to passenger rail systems. This is NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems, 2010 Edition. NFPA’s Fixed Guideway Transit Systems Technical Committee was originally formed in 1975. As stated in the “Origin and Development” section of the standard, one of the primary concerns of the committee
in the preparation of the original standard was the “potential for entrapment and injury of large
numbers of people who routinely utilize these mass transportation facilities” (National Fire
Protection Association [NFPA], 2010, p. 130-1). Furthermore, the goal of the standard is “to
protect occupants not intimate with the initial fire development” and to “maximize the
survivability of occupants intimate with the initial fire development” (NFPA, 2010, p. 130-11).

This standard was consulted in order to help answer the 2\textsuperscript{nd} research question; i.e., what
are the potential events associated with rail service, An examination of the Table of Contents of
the standard reveals that the standard encompasses detailed requirements for all aspects of the
train system, from the stations and train equipment, to the trackway itself (NFPA, 2010, p. 130-5).

Chapter 4, Section 4.5 of the standard, “Shared Use by Freight Systems” requires that
“where passenger and freight systems are operated concurrently through or adjacent to stations
and trainways, the design of the station and trainway life safety from fire and fire protection
systems shall consider the hazards associated with both uses, as approved” (NFPA, 2010, p. 130-12).

Similarly, Chapter 9, Section 9.3 of the standard, “Emergency Procedures” requires the
rail operator to prepare an emergency management plan to address the following emergencies:

- Fire or smoke within the system structures (stations, trackways, and support
  facilities)
- Collisions or derailments involving rail vehicles on the trainway, rail vehicles
  with privately owned vehicles, and intrusion into the right of way from adjacent
  roads or properties
- Loss of primary motive power resulting in stalled trains
• Evacuation of passengers from a train to all right-of-way configurations under circumstances where assistance is required
• Passenger panic
• Disabled, stalled, or stopped trains due to adverse personnel/passenger emergency conditions
• Tunnel flooding
• Disruption of service due to disasters or dangerous conditions adjacent to the system, such as hazardous material spills on adjacent roads or police activities or pursuits dangerously close to the operational system
• Structural collapse or imminent collapse of authority property or adjacent property that threatens safe operation of the system
• Hazardous materials accidently or intentionally released into the system
• Serious vandalism or criminal acts, including terrorism
• First aid or medical care for passengers on trains and in stations
• Extreme weather conditions
• Earthquake
• Any other emergency as determined by the authority having jurisdiction (NFPA, 2010, p. 130-33)

Finally, Annex D of NFPA 130 (NFPA annexes of their standards are not part of the requirements of the standards, but are included for informational purposes) “provides additional information on the hazards associated with burning rail vehicles and the impact of a burning vehicle on the evacuation of passengers and crew to a point of safety” (NFPA, 2010, p. 130-51). This annex describes the modes of fire development inside and outside the rail vehicles. An
examination of this annex (Section D.3.2) in order to help answer the research questions, and in particular question (3), what are the Marin County Fire Department's equipment and personnel needs to address these incidents?, was instructive in pointing out that initiating fires on the exterior of the vehicle, particularly from adjacent automobiles can become very large (in excess of 5 MW) and include fuel spills. Such a fire could ignite combustible materials on the exterior of the rail vehicle and/or penetrate the openings of the rail car, thereby effecting passenger safety and egress (NFPA, 2010, p. 130-52).

Other NFPA Standards reviewed include NFPA 402, *Guide for Aircraft Rescue and Firefighting Operations*, 2008, and NFPA 502, *Standard for Road Tunnels, Bridges, and Other Limited Access Highways* 2008, both of which were referenced in the aforementioned NFPA 130 (National Fire Protection Association [NFPA], 2008, p. 9). According Joseph B. Zicherman, PhD, a member of the NFPA 130 Technical Committee (Zicherman, personal communication, July 2, 2012), NFPA 402 was referenced in NFPA 130 due to the parallels with regards to egress issues between commercial aircraft and rail cars. Chapter 6 (Emergency Response) of NFPA 402 is relevant to the research questions of this paper. Specifically, Section 6.1.1 discusses passenger section tenability limits during exterior fuel fires. While these tenability limits would most likely be of longer duration for a rail car versus an aircraft due to the materials used in construction of the exterior skin of the vehicles (aluminum aircraft skin vs. stainless steel rail car skin), and the quantities of fuel burning in any reasonable rail car fire scenario, it is an important factor to consider when identifying first responder access points (NFPA, 2008, p. 402-14).

Similarly, Section 6.1.5 states in part that “all-weather access routes should be designated and maintained in usable condition” (NFPA, 2008, p. 402-14).
Section 3.3.30.4 of NFPA 502 defines a “Limited Access Highway” as a “highway where preference is given to through-traffic by providing access connections that use only selected public roads and by prohibiting crossings at grade and at direct private driveways” (National Fire Protection Association [NFPA], 2011, p. 502-8). This definition is directly analogous to rail right-of-way. Chapter 5, Section 5.2 requires in part that any emergency planning process for these limited access highways include arrangements for fire apparatus response and access (NFPA, 2011, p. 502-9). Chapter 13 of NFPA 502, “Emergency Response”, and specifically Section 13.2 “Emergencies” has basically an identical list of types of emergencies for which the Authority Having Jurisdiction is responsible for developing plans as the corresponding Section 9.3 of NFPA 130 (National Fire Protection Association [NFPA], 2011, p. 502-20).

Also, in addressing the second research question (what are the potential events associated with rail service with which the Marin County Fire Department will be expected to contend?), this researcher need only consult the student manual of a fire investigation class attended in 2005, FI-210, Wildland Fire Origin and Cause Investigation (National Wildfire Coordinating Group [NWCG], 2005, Chapter 6B). This manual lists several wildland fire ignition sources for the trains/consists themselves, as well as rail operations associated with traffic and track maintenance.

Similarly, another manual pertinent to this research project is the *Railroad Fire Prevention Field Guide*, (CALFIRE, 1999). This document provides inspection procedures for fire service personnel, describes rail equipment that serve as common sources of ignition, as well as information as to where and why fires caused by trains and rail operations are likely to occur. For example, fires are more likely to occur due to the expelling of carbon from the diesel engine’s exhaust system, where sections of track are on grades where the train needs to
accelerate. Similarly, on those sections of track where the train needs to apply its brakes, more fires occur due to the expelling of brake shoe lining/material (Department of Forestry and Fire Protection, 1999, p. 13).

In addition, a query of the National Fire Information Reporting System (NFIRS) by the California State Fire Marshal’s Office was requested. The search query was undertaken using all NFIRS ignition causes associated with rail systems. Specifically, the codes searched and their definitions are as follows (National Fire Information Reporting System [NFIRS], 2012):

Fire incidents involving “mobile property” types:

- 31 Diner car, passenger car.
- 32 Box, freight, or hopper car.
- 33 Tank car.
- 34 Container or piggyback car (see 73 for container).
- 35 Engine/locomotive.
- 37 Maintenance equipment car. Includes cabooses and cranes.
- 30 Rail transport vehicles, other.
- Fire incidents involving “fixed property” use codes 174 and 175 (street level and underground passenger rail terminals).

Similarly, a search of the Federal Railroad Administration’s (FRA) Office of Safety Analysis was undertaken to examine the federal statistics for rail incidents. Since Marin County has not had rail service for several decades, a query was made for incidents over the past 10
years in California, and a map of incidents in California over the same period. For the total incidents in California for the past 10 years (January 2002 through April, 2012), there were 1734 incidents reported. The main categories of incident causes/failures were Equipment, Highway/Rail, Human, Miscellaneous, Signal, and Track. For this period, there were 1734 incidents. Of these incidents there were 229 in the category of Highway/Rail, of which 38 were collisions. Of the hundreds of types of incidents listed in the main categories, only two involved fires (“oil/fuel fire”, and “fire, other than vandalism”). Of these fire related causes, there were two oil/fuel fires, and one “fire, other than vandalism” (Department of Transportation, 2012, p. 3.10). There was no other delineation or identification of fires or fire related incidents.

The literature search also yielded several Executive Fire Officer Program (EFOP) Applied Research Papers (ARP) related to this subject, of which four were extensively reviewed. In Orange County Risk Assessment of Train Traffic, Richard Saez (2011), Saez’s research questions were related to the risks: geographical, hazardous materials, risk to passengers as well as emergency responders (Saez, 2011, p. 3). Saez’s research indicated that the main threat/risk to their jurisdiction was a hazardous materials release due to a train collision/derailment. This is in large part due to the types of commodities transported by the freight rail operator in Orange County, Florida (Saez, 2011, p. 13). As such, Saez recommended that all critical facilities within evacuation/isolation zone (as determined by the most hazardous commodity transported by the rail authority) prepare a pre-incident action plan. Saez also recommended that the local fire company of each targeted facility conduct drills executing the facilities’ plans (Saez, 2011, p. 18).

In Dealing with Light Rail Emergencies in Cooperation with Dallas Area Rapid Transit (DART), Mike D. Jones’ four research questions were directly applicable to this research project:
What are some of the emergency response issues pertaining to passenger rail emergencies?
What kind of light rail emergencies typically occur in other areas DART serves? What are some of the proactive measures DART has taken to prevent emergency incidents? How should his department (Richardson Fire Department) prepare for a light rail emergency (Jones, 2004, p. 2)?

Jones’ research indicated that the emergency response issues of most concern was right-of-way access since there are elevated sections of track as well as tunnels, and shock hazard to emergency responders since in contrast to diesel powered SMART rail vehicles, DART rail vehicles are powered by overhead electrical power (845 V-DC) (Jones, 2004, p. 16). Jones’ research also indicated that the majority of emergency calls requiring the response of the Dallas Fire Department have been at grade crossings where vehicle traffic ignored operating warning devices (Jones, 2004, p. 12). EMS responses were infrequent, with the train proceeding to the next station where the ambulance is met (Jones, 2004, p. 12).

According to Jones, DART officials were very proactive in identifying safety issues and problems prior to initiating operations, touring the country and examining operating fixed-guideway rail systems (Jones, 2004, p. 21). In fact, DART officials undertook many of the requirements of NFPA 130 with regards to pre-incident planning and incident procedure manuals, fire-safety analysis of the system and vehicles, as well as training with local emergency responders all of which measures have been incorporated in subsequent versions of NFPA130 (Jones, 2004, p. 22).

Since Jones identified that any large incident would quickly expend Richardson Fire Department’s resources, he identified extensive pre-planning with DART personnel as being essential (Jones, 2004, p. 25). Such pre-planning would include topics such as dispatching the appropriate emergency response to the scene, evaluating and establishing the parameters of the
emergency, coordinating with other agencies, determining DART’s scope of function and responsibility, and emergency procedures and priorities. Other concerns identified included planning for extended operations, logistical considerations, and winding down operations (Jones, 2004, p. 25).

Similarly, in On Track to Disaster: Railroad Emergencies in Oakland Park, John L. Preston asked the following research questions directly applicable to this project: What are the hazards and risks associated with railroad operations in Oakland Park? What are the critical elements that must be included in a railroad emergency response plan for Oakland Park (Preston, 2011, p. 3)? Similarly to the aforementioned Saez’s research results, the primary concern of Preston was a hazardous materials release incident due to a collision or derailment of a freight train travelling through Oakland Park, and its potential effect on critical infrastructure, such as a water treatment plant (Preston, 2011, p. 64). Preston also cited the potential for a mass-casualty incident due to Amtrak’s service through Oakland Park. Finally, as a danger to emergency responders, Preston cited the risk imposed by the train locomotives, irrespective of the freight or number of passengers in the train. The risks cited include the fuel oil for the diesel engine, battery acid, coolant, and the “head end power generator” (HEP), which provides electricity for lighting, and HVAC throughout a passenger train. Preston indicated that the HEP may produce up to 480 Volts at 1200 amps AC (Preston, 2011, p. 66).

In Railroad Risk Assessment-Developing a Methodology (2009), R. Allen Cain research focused on identifying and determining the probability of those identified risks occurring in Cary, North Carolina (Cain, 2009, p. 3). Cain’s research findings with regard to passenger rail operations echoed that of Saez in that greatest risk was grade crossing collisions with vehicles and trucks carrying hazardous materials at grade crossings (Cain, 2009, p. 25).
Finally, in *Light Rail Rescue Operations in the City of Norfolk, Virginia*, Michael T. Brooks identified identical issues to previously cited research papers; i.e., access issues for emergency responders, and that the most probable incident facing the fire service is collisions with vehicles at grade crossings (Brooks, 2010, p. 16). Brooks also identified the need for familiarization by the fire service with the operation of the rail equipment and system, as well as the system operator’s safety procedures to be of primary importance (Brooks, 2010, p. 17).

An examination of SMART’s web site yielded several “white papers” related to the research questions of this project. These white papers’ subjects included a general overview of the system, a description of the proposed rail vehicles, a description of SMART’s diesel trains, a description of SMART’s two-way train operation, a description of the relationship between SMART and the freight train operator, North Coast Railroad Authority (NCRA), an article on rail safety compared to travelling by automobile, and an article on SMART’s effect on city traffic (SMART, 2008). Other documents downloaded from SMART’s website include *Vehicle Technology Assessment Final Draft Report* (LTK Engineering Services, 2009), *SMART Technical Specification for Diesel Multiple Units (DMUs)* (SMART, 2010), and *Sonoma-Marin Area Rail Transit District: Passenger Rail & Pathway Project Description* (SMART, 2010).

The aforementioned “white papers” were written by SMART in response to its defeat in the November, 2006 election. After this initial election defeat (a measure to raise the sales tax by one-quarter of one percent in Sonoma and Marin Counties to pay for the project), an ad-hoc committee was formed by SMART to meet with stake-holders, government officials, opponents of the measure, community groups, etc., to determine what went right with the election effort, and where these groups felt the project fell short. One result of these meetings was that SMART needed to better explain the project to the public, and to clear up misunderstandings and
misconceptions about various components of the project, hence the preparation of fact sheets or “white papers” ("What is SMART?," n.d., p. 1).

SMART White Paper #5 discusses the parameters of the two main types of Diesel Multiple Units (DMU). Light DMUs are constructed of lighter materials such as aluminum, while heavy DMUs have steel bodies and skins. Summarizing, SMART is required to operate “Heavy” DMUs in order to comply with FRA regulations for passenger rail operations shared with freight operations because of the better impact resistance of steel-bodied cars ("SMART’s Rail Vehicles," 2008, p. 2).

An unasked question related to the last research question of this research project (What are the mitigating measures that may be taken to reduce the impact of the incidents that may occur?) is what regulatory authority has jurisdiction over this rail project and its operations? After all, if the jurisdiction/regulatory authority of the local fire jurisdiction(s) through which the right-of-way passes have limited authority to enforce fire and life safety issues, MCFD’s power to compel SMART and NCRA to comply with any requirements to mitigate the impact of rail incidents MCFD recommends will be limited.

While not directly regulating rail operations, the California Public Resources Code (enforceable in SRA) has several code sections directly related to rail operations. Of specific relevance to this research project is Section 4296.5, which states in part that “any person operating a railroad on forest, brush, or grass covered land shall…destroy remove, or modify so as not to be flammable any vegetation or other flammable material…on the railroad right-of-way…” (California Public Resources Code, 2011). Similarly, Title 14, Article 2, Fire Hazard Reduction Standard for Railroad Right-of-Way of the California Code of Regulations has detailed requirements for the management of flammable and combustible materials adjacent to
rail right-of-way. Specifically, Section 1293 specifies 10-25-feet of combustible/flammable material management adjacent to the right-of-way, 5-ft for the inlet and outlet of culverts within 25-ft of the outside rail, and 30-ft from tunnel portals (California Code of Regulations, 1989).

SMART’s operations are governed by the Federal Railroad Authority (FRA), which is under the umbrella of the Federal Department of Transportation (DOT), and was established in 1966 to (in part) promote and enforce railroad safety (Federal Railroad Administration website, n.d., p. 1). Specifically, FRA 49CFR 200 through 250 regulate passenger rail operations. Of relevance to this research project are Parts 238 Passenger Equipment Safety Standards and 239 Passenger Emergency Preparedness (Transportation, 2007). These Parts require a system-wide and rail car fire safety analysis be conducted, and a passenger train emergency preparedness plan be prepared by the system operator, respectively.

In addition to aforementioned Annex D of NFPA 130, both ASTM, and APTA have developed methodologies/guides to conducting the required passenger rail car and system safety analysis. ASTM E2061-09a uses a performance-based approach to assess fire safety in rail transportation vehicles. Their approach requires developing all crucial fire scenarios that must be considered, and evaluating the effect of all foreseeable rail car contents/components as well as rail passenger vehicle design factors which could potentially affect the severity of the resulting fire hazard.

The steps to be used in conducting a fire hazard assessment are detailed in Section 5.6 of the guide, are summarized below (American Society for Testing and Materials [ASTM], 2009, p. 8):

- Develop and identify the fire safety objectives to be achieved.
• Specify the design being assessed such that the fire safety performance of the
design can be tested and/or modeled.
• Specify the fire scenarios for which the design must meet the fire safety
objectives.
• Specify the assumptions made, such as environmental conditions.
• Use testing and calculations to determine whether the objectives will be met by a
specified design for a specified fire scenario.

APTA’s guide *Manual for the Development of System Safety Program Plans for
Commuter Railroads* (American Public Transportation Association [APTA], 2006, p. 7), NFPA
130 (NFPA, 2010, p. 58), as well as the FRA’s *Collision Hazard Analysis Guide* reference the
DOD’s MIL-STD-882D *System Safety Program Requirement* (Department of Defense [DOD],
2000). As stated in FRA’s guide, MIL-STD-882 “…the disciplined, structured approach
outlined in MIL-STD-882 allows hazards to be systematically identified, analyzed, and
addressed. The MIL-STD-882 methodology also ensures that all hazards and mitigation
strategies are adequately reviewed. The process provides a permanent record of the hazard
analysis and serves as a reference document to review and analyze future incidents, accidents, or
changes in system operations (Department of Transportation, 2007, p. 7).” All of the
aforementioned guides and manuals provide systematic methodologies for developing system
and rail car safety analysis plans, as well as overall system safety program plans in the case of
APTA’s guide.

Summarizing, the literature search revealed the following:
• There is a dearth of information and literature regarding fire incidents in rail systems in general, and in particular passenger rail systems. Both the FRA and NFIRS databases show very little fire activity.

• There is very little guidance in NFPA on the appropriate fire service response to rail incidents.

• The literature contains several methodologies and guides to conducting passenger rail car and system safety analysis as required by the FRA regulations.

• The most likely type of rail incident cited in the literature is train/vehicle collisions at grade crossings. Also, another type of incident for which MCFD is likely to respond is vegetation/wildland fires caused by equipment failures.

• In order to mitigate rail incidents, it is important for the fire service to conduct thorough pre-planning and operational training/equipment familiarization with the rail operator.

Procedures

This Applied Research Project utilized several avenues to gather data to accomplish the project’s goals. As part of the literature review, a systematic on-line search was conducted using key-words such as “Train Accidents”, “Rail Accidents”, “Train Fires”, and “Rail Fires”, and the same phrases but with “Commuter” and “Passenger” appended using the BING and Google search engines. This search began at the Learning Resource Center at the NFA in January 2012, and continued from this researcher’s home agency until the conclusion of the project.

To answer the first research question, the Marin County Assessor’s Parcel Data (Marin County Assessor’s Office, 2011, table 1) was accessed and processed using Geographic Information System (GIS) mapping software (ESRI ArcGIS Version 10.0) to geographically
locate assets at risk in proximity to the SMART right-of-way. To determine the zone adjacent to
the right-of-way which assets of risk are located; i.e., the quantity and type of hazardous
materials associated with the freight and rail traffic were identified through personal interviews,
as well as SMART documents downloaded from the web. From this information, the 2012
Emergency Response Guide Book (U.S. Department of Transportation, 2012) was consulted to
determine the appropriate zones/distance from the right-of-way that would be influenced. Data
regarding Pacific Gas and Electric (PG&E) natural gas pipeline network was also obtained from

A direct search of several government agency sites was conducted, as well. These sites
included SMART, Golden Gate Transit District, Department of Defense (DOD), Department of
Transportation (DOT), CALFIRE, Federal Emergency Management Agency (FEMA),
Department of Homeland Security (DHS), National Fire Administration (NFA), National
Institute of Standards and Technology (NIST), National Wildfire Coordinating Group (NWCG),
and the State of California.

Also searched directly over the internet were several private organizations such as NFPA,
and American National Standards Institute (ANSI), APTA, ASTM, SMART, and the Society of
Fire Protection Engineers (SFPE). Several publications’ databases of past articles related to this
research project were searched, as well. These publications included Fire Engineering, Fire
Science Magazine, and Fire Chief Magazine.

Unstructured private interviews were conducted, as well. These interviews were held
with a passenger rail fire expert, SMART and Northwest Pacific Railroad, PG&E and MCFD
personnel. The specific individuals and their contact information are listed in Appendix B, and
were Joseph D. Zicherman, PhD, Fire Cause Analysis, Fred Codoni, Interim Deputy Fire Chief
Mark Brown (MCFD), John Velasquez (PG&E), John Zanzi (SMART), and John Williams
(NWP).

Dr. Zicherman was consulted for his expertise on fire safety analysis of passenger rail
vehicles. He is also a member of the NFPA 130 Technical Committee. Mr. Codoni was
consulted for information regarding the history of rail activities in Marin County. Mr. Codoni
retired as the manager of Southern Pacific Railroad’s Loading Service, and is the co-author
Northwest Pacific Railroad (2006) with Paul Trimble. Chief Brown was consulted as the Marin
County USAR Team’s leader for information regarding their capabilities. John Velasquez is a
Senior Public Safety Specialist, providing information regarding PG&E’s natural gas pipeline
network. John Zanzi serves as SMART’s Safety and Emergency Response Specialist, and John
Williams is CEO of NWP. They were interviewed for information regarding SMART and NWP
operations, respectively.

The limitations encountered by this researcher were three-fold. First, the rail cars
planned for use in the SMART are in the process of being built and none have been delivered.
As such, no direct examination of the equipment was possible. Similarly, much of the right-of-
way is inaccessible, with SMART only recently beginning the rehabilitation of the right-of-way.
Finally, the data available through the FRA and NFIRS system does not shed much light on the
actual cause of fires experienced, other than phrases such as “equipment failure”.

Results

The first research question was what assets and critical infrastructure is at risk
from rail operations. From the literature review and internet search, hazardous material releases
are a major concern for emergency responders during rail operations. Interviews with John
Williams, CEO of NWP (Williams, personal communication, July 19, 2012) indicated that the commodities transported do not include hazardous materials. As such, the most likely hazardous material release would be from a ruptured diesel fuel tank on the locomotive.

Utilizing the 2012 Emergency Response Guide Book (U.S. Department of Transportation, 2012) for a diesel fuel fire incident, diesel fuel’s 3-digit guide number is 128, and indicates for a spill to consider evacuation 300-meters downwind, and for a fire isolate and evacuate 800-meters (1/2-mile) in all directions (U.S. Department of Transportation, 2012, p. 194). These precautions also match those required for guide number 111, “unspecified cargo/mixed load” (U.S. Department of Transportation, 2012, p. 160). Using this 1/2-mile hazard/buffer zone, it was determined that there are 119 assets and critical infrastructure at risk, which includes five SMART stations yet to be constructed (Sonoma Marin Area Rail Transit [SMART], 2010, p. 11-14). Although all of these assets/critical infrastructure would not be affected during any one incident, their number and distribution along the entire right-of-way may necessitate evacuation of several facilities during any one incident.

In addition to the above facilities, the rail right-of-way is in close proximity to another major component of critical transportation infrastructure, Highway 101, as well as both of Marin County’s airports. Highway 101 is the only major north-south motor vehicle transportation throughway in the county. The aforementioned components of critical transportation infrastructure are in extremely close proximity to PG&E’s major natural gas transmission lines (Figure 4, Appendix A).

Similarly, the research revealed that there are 20 grade crossings in Marin County (Sonoma Marin Area Rail Transit [SMART], 2010, p. 14-17). The research also indicated that
the most likely type of incident to which MCFD would respond is a train/vehicle collision at a grade crossing.

Of the list of rail associated incidents for which the rail operator is responsible for developing emergency procedures (see p. 11-12), MCFD has direct responsibility for only one type of incident, “…disruption of service due to disasters or dangerous conditions adjacent to the system…”, which in this case would be wildland/vegetation fires (NFPA, 2010, p. 33). Other types of incidents listed include collisions/derailments, hazardous material releases, and fire and smoke within the system structures. However, for these incidents, MCFD would be responding as a mutual aid resource.

The aforementioned wildland fire incident is a type of incident for which MCFD would have primary responsibility for emergency response. The research indicated that fires are more likely to occur due to the expelling of carbon from the diesel engine’s exhaust system, where sections of track are on grades where the train needs to accelerate (Department of Forestry and Fire Protection, 1999, p. 13). Similarly, on those sections of track where the train needs to apply its brakes, more fires occur due to the expelling of brake shoe lining/material. Similarly, the research yielded several common causes of the vegetation fires, including (NWCG, 2005, p. 6B.18):

- Exhaust Carbon
- Brakeshoe Particles
- Track Maintenance (hot work)
- Right-of-way-burning (prescribed/controlled vegetation management burning)
- Dynamic grid failure
- Torpedoes (small explosive charges placed on the track to warn train operators of upcoming track hazards)
- Flares
- Wheel slip
- Journal box failure (hotbox)
- Cracked sump oil ejected into exhaust stream

MCFD’s history, evolution service area and development make MCFD the preeminent wildfire agency in Marin County. Because of MCFD’s contract with CALFIRE, MCFD has primary responsibility for suppression of wildfires in the county’s SRA, regardless of jurisdictional boundaries. The contract also enables MCFD to access CALFIRE resources directly (and in particular fixed and rotary winged fire suppression aircraft) for any wildfire in or threatening the county’s SRA. As such, MCFD is well equipped to deal with any wildland fire caused by rail operations.

For those rail incidents for which MCFD will respond through mutual aid (most likely extrication/rescue incidents involving passenger rail cars and vehicles), MCFD has extensive experience due in part to the nature of its service area. MCFD’s Engine 1556 is also equipped enhanced extrication tools than that carried in MCFD’s typical engines, including vehicle stabilization struts and Hurst tools with stronger jaws, and longer rams, as well as 27-ton capacity inflatable lifting bags (D/C Mark Brown, personal communication, July 19, 2012). In addition, the County’s USAR apparatus is housed in MCFD’s facilities in Woodacre, and a nearby county corporation yard (Nicasio). According to MCFD’s Deputy Chief Mark Brown, Marin County’s USAR Team is a Regional Task Force (typed by CAL-EMA). As such, the USAR Team, with 29 personnel has search, rescue (2-6 person rescue crews), medical and
logistics components, as well as a heavy-rescue rigging crew. Given these resources and expertise of MCFD, the most likely types of incidents associated with rail traffic (vehicle/train collisions) and MCFD’s response capabilities with regard to vehicle extrication and heavy rescue, MCFD is adequately equipped and staffed. As such, in answering the third research question, the research indicated that MCFD is adequately staffed and equipped for any reasonably conceivable incident involving rail.

In answering the fourth research question, what are the mitigating measures that may be taken to mitigate the impact of rail emergency incidents, the research indicates that MCFD has statutory and jurisdictional limitations that will prevent significant influence on the operations of the rail service. The major mitigating measures to be taken to limit the impact of rail emergencies will be addressed in the system safety plans for which the operator has the responsibility to develop.

However, MCFD can exert some influence on certain aspects of operations, including the notification of SMART and NWP of critical fire weather, thereby allowing them to make adjustments in their operations during these periods. MCFD can also enforce the California Public Resources Code’s (PRC) (enforceable in SRA) and California Code of Regulations (CCR) sections directly related to rail operations. Specifically, Section 4296.5 of the PRC states in part that “any person operating a railroad on forest, brush, or grass covered land shall…destroy remove, or modify so as not to be flammable any vegetation or other flammable material…on the railroad right-of-way…” (California Public Resources Code, 2011). Similarly, Title 14, Article 2, Fire Hazard Reduction Standard for Railroad Right-of-Way of the CCR has detailed requirements for the management of flammable and combustible materials adjacent to rail right-of-way. Specifically, Section 1293 specifies 10-25-feet of combustible/flammable material
management adjacent to the right-of-way, 5-ft for the inlet and outlet of culverts within 25-ft of the outside rail, and 30-ft from tunnel portals (California Code of Regulations, 1989).

MCFD can also require “hot-work” permits for maintenance and repair operations in SRA. Finally, while not necessarily a direct mitigating measure, MCFD will enhance their effectiveness responding to rail incidents, and thusly reduce the impact of the incident, by conducting training and equipment familiarization with the SMART and NWP system operators.

Finally, the research and in particular the Applied Research Papers reviewed, emphasized thorough and close pre-planning and training with the rail operators. These activities should also include a complete review of the operators system and rail car safety analysis. These activities will also enhance incident mitigation efforts.

Finally, GIS analysis revealed that SMART shares approximately 11 miles of track with the freight operation. Also, there are 17 miles of right-of-way in SRA and/or within ½-mile of SRA. Furthermore, the rail and natural gas pipeline system are both located in very active seismic/soil liquefaction zones (Figures 5 and 6, Appendix A).

Discussion

This research project has examined the effect that the re-introduction of freight and passenger rail traffic in Marin County will have on the MCFD. To determine the direct effect rail operations will have on MCFD, four research questions were posed: What are assets, target hazards, and critical infrastructure at risk? What are the potential events associated with rail service with which the Marin County Fire Department will be expected to contend? Given the results of the second question, what are the Marin County Fire Department's equipment and personnel needs to address these incidents? What are the mitigating measures that may be taken to reduce the impact of the incidents that may occur?
The rail right-of-way itself is critical infrastructure. This is due to the fact that Marin County is in an active seismic zone, and may need to depend on rail transport to deliver food, water, medical and other critical needs of the population should a major earthquake occur. In addition, the rail right-of-way is in close proximity to another major component of critical transportation infrastructure, Highway 101, as well as both of Marin County’s airports.

Highway 101 is the only major north-south motor vehicle transportation throughway in the county. The aforementioned components of critical transportation infrastructure are in extremely close proximity to Pacific Gas and Electric’s (PG&E) major natural gas transmission lines (Figure 3, Appendix A). However, this discussion in terms of critical infrastructure in the event of a seismic event may be a moot point given both corridors and airports are located in areas of significant liquefaction ("Liquefaction Hazard Maps," 2012, p. 1) and shake zones ("Soil Type and Shaking Hazards in the San Francisco Bay Area," 2012, p. 1), per the USGS maps (Figures 5 and 6, Appendix A).

In order to determine what other critical infrastructure and assets-at-risk from freight and passenger rail operations, the hazard zone had to be determined. SMART White Paper No. 14, *Freight Trains and Passenger Trains*, indicates that the NCRA has “perpetual and exclusive easement to operate freight rail service on the SMART-owned tracks from Healdsburg (Sonoma County) to the Ignacio Wye at Highway 37 in Novato” ("Freight Trains and Passenger Trains," 2008, p. 14:1) (Figure 1, Appendix A). According to an article from the Santa Rosa Press-Democrat found on NCRA’s website, the freight operation will only be transporting heavy commodities (lumber, grain, right-of-way ballast material and concrete rail ties for SMART), and solid waste from Sonoma County landfills (Hart, 2011, p. 1). The article also mentions that...
the track can accommodate freight train speeds up to 45 mph, but will be averaging speeds of 25 mph.

In a conversation with John Williams, CEO of Northwestern Pacific Railroad, the freight train operator (NWP), Mr. Williams indicated that non-hazardous materials is all that NWP is authorized to transport per the FRA (Williams, personal communication, July 19, 2012). He indicated that NWP would need to finance substantial improvements to the NCRA/SMART owned right-of-way, as well as provide increased levels of training to NWP’s train operators if NWP were to transport hazardous materials. He also mentioned that NWP has not received any requests to transport hazardous materials.

Given the cargo that NWP is authorized to carry, the most likely hazard is a fire from a ruptured diesel fuel tank as a result of grade crossing collision or train derailment. According to the 2012 Emergency Response Guide Book, diesel fuel’s 3-digit guide number is 128, and indicates for a spill to consider evacuation 300-meters downwind, and for a fire isolate and evacuate 800-meters (1/2-mile) in all directions (U.S. Department of Transportation, 2012, p. 194). These precautions also match those required for guide number 111, “unspecified cargo/mixed load” (U.S. Department of Transportation, 2012, p. 160). As shown in Figure 3, Appendix A, any such event will present a number of issues, including the probable closing of Highway 101. Furthermore, since the SMART DMUs will be diesel powered, these same precautions would apply on the portion of the right-of-way not utilized by freight operations; i.e., a diesel fuel fire.

The assets at risk listed below are within ½-mile of the railroad right-of-way and included the following facilities (the number in parenthesis is the number of each respective facility within ½-mile of the right-of-way):
In addition to the above facilities, SMART plans to construct five train stations in Marin County ("Downtown Traffic and SMART," 2008, p. 2). Obviously, any one incident is not going to place all 119 of these assets at risk. However, their number and distribution along the right-of-way may threaten several target hazards/assets at risk during any single event. Also, among the facilities at risk is one of the three major Marin County Hospitals (Novato Community Hospital), as well as the seat of county government, the Marin Civic Center.

Another target hazard not listed above is PG&E’s main natural gas transmission and distribution (pressure greater than 60-psig) pipeline and associated valves, most of which is
within the right-of-way buffer zone, if not within mere feet of the right-of-way (113 of the
aforementioned valves are within the right-of-way ½-mile hazard zone)
(https://www.pge.com/firstresponder/pageflow/home/HomeController.jsp). According to
Michael Velasquez, PG&E’s Senior Public Safety Specialist, PG&E has no data on the depth-of-
cover for the pipelines (some were installed as long ago as the 1950’s). As such, the severity of
the hazard represented by this system is unknown (Velasquez, personal communication, July 18,
2012).

The research clearly showed the most probable incident with which the Marin County
fire service will be forced to contend is vehicle collisions with the SMART train at the 20 grade
crossings. In Orange County Risk Assessment of Train Traffic, Richard Saez (2011), Saez’s
research indicated that the main threat/risk to their jurisdiction was a hazardous materials release
due to a train collision/derailment at grade crossings. This is in large part due to the types of
commodities transported by the freight rail operator in Orange County, Florida (Saez, 2011, p.
13). Similarly, in Dealing with Light Rail Emergencies in Cooperation with Dallas Area Rapid
Transit (DART), Mike D. Jones’ research also indicated that the majority of emergency calls
requiring the response of the Dallas Fire Department have been at grade crossings where vehicle
traffic ignored operating warning devices (Jones, 2004, p. 12).

As previously mentioned, these findings were echoed in On Track to Disaster: Railroad
Emergencies in Oakland Park, where the primary concern of Preston was a hazardous materials
release incident due to a collision or derailment of a freight train travelling through Oakland
Park, and its potential effect on critical infrastructure (Preston, 2011, p. 64). In Railroad Risk
Assessment-Developing a Methodology (2009), R. Allen Cain’s research findings were that
greatest risk was grade crossing collisions with vehicles and trucks carrying hazardous materials
at grade crossings (Cain, 2009, p. 25). Finally, in Light Rail Rescue Operations in the City of
Norfolk, Virginia, Michael T. Brooks identified that the most probable incident facing the fire
service is collisions with vehicles at grade crossings (Brooks, 2010, p. 16).

The web search focused on the second and third research questions; the types of incidents
for which emergency services respond, as well as operational considerations and procedures for
emergency personnel responding to rail incidents. There is a long and well documented history
of rail collisions, derailments, and hazardous material releases as a result of derailments and
collisions at grade crossings. Very little information was found regarding operational/1st
responder considerations involving passenger rail cars. What information that was available was
typified by that obtained from a Fire Engineering magazine article Light Rail Incidents: From
Response to Extrication. While much of this article focuses on the electrical hazards associated
with light rail incident management, which will not be an issue for SMART incidents, the
balance of the article focuses on extrication problems (Blount, 2010, p. 5). These articles made
apparent the need for 1st responders to become familiar with the rail vehicles’ lifting points,
electrical hazards from HEP, and access points in order to facilitate extrication operations from
the passenger rail cars.

Of relevance to this research project’s third question, “what are the MCFD equipment
and personnel needs to address these incidents”, Preston in On Track to Disaster: Railroad
Emergencies in Oakland Park included an operating guideline for railroad emergencies as
Appendix D (Preston, 2011, p. 112). Preston includes factors to consider for locomotives, tank
cars, box cars, as well as passenger rail vehicles. However, in the case of passenger rail vehicles
Preston does not provide information on equipment or personnel needs for the initial response.
Instead, he provides general safety information regarding the tracks and surrounding rail environment (Preston, 2011, p. 121).

MCFD does not have a direct response responsibility for incidents in the rail right-of-way, other than vegetation/wildland fires in SRA. However, it is likely that MCFD will respond to these incidents due to the county fire services’ master mutual aid agreement. MCFD has extensive experience with vehicle extrication operations due in part to the nature of its service area. MCFD’s Engine 1556 is also equipped enhanced extrication tools than that carried in MCFD’s typical engines, including vehicle stabilization struts and Hurst tools with stronger jaws, and longer rams, as well as 27-ton capacity inflatable lifting bags (D/C Mark Brown, personal communication, July 19, 2012). In addition, the County’s USAR apparatus is housed in MCFD’s facilities in Woodacre, and a nearby county corporation yard (Nicasio).

According to MCFD’s Deputy Chief Mark Brown, Marin County’s USAR Team is a Regional Task Force (typed by CAL-EMA). As such, the USAR Team, with 29 personnel has search, rescue (2-6 person rescue crews), medical and logistics components, as well as a heavy-rescue rigging crew. Chief Brown mentioned that in class he recently attended (Advanced All Incident Management), one of the exercises performed in the class was a passenger/freight rail collision. In that exercise, Marin County’s USAR Team was deployed to the incident, and has been placed on Cal-Fire’s resource ordering list for any such incidents (D/C Mark Brown, personal communication, July 19, 2012).

An examination of the route of SMART’s right-of-way reveals that the route does not travel through MCFD’s direct protection area/response jurisdiction (MCFD contracts with San Rafael Fire Department for fire and EMS responses in the unincorporated areas of San Rafael
through which SMART passes, see Figure 2, Appendix A). However, as previously mentioned
MCFD has direct responsibility for wildfire suppression and prevention in Marin County’s SRA.

As such MCFD will be responsible for any wildland fires caused by SMART operations.

Furthermore, recent policy shifts at Cal-Fire have caused MCFD to be more aggressive and
initiate a full-wildland response to vegetation/wildland fires that threaten the SRA, generally
within 1/2-mile of the SRA (Figure 4, appendix A). As such, all of the rail row is either in SRA,
or within ½-mile of SRA. This may therefore affect SMART’s operations as a wildland fire
approaches the row (SMART being “critical infrastructure”), affecting operations, as well as a
wildland fire initiating from SMART’s operations affecting operations due to MCFD’s
suppression activities.

Since wildland fire in SRA and threatening SRA are the only direct protection/response
responsibilities MCFD will have with regards to the reintroduction of rail traffic in Marin
County, an examination of Cal-Fire’s Railroad Fire Prevention Field Guide (1999), as well as
NWCG’s Wildland Fire Cause and Origin Determination, FI-210 (2005) was warranted. Per the
latter document, railroad vegetation fire ignition mechanisms include the following (NWCG,
2005, p. 6B.18):

- Exhaust Carbon
- Brakeshoe Particles
- Track Maintenance (hot work)
- Right-of-way-burning (prescribed/controlled vegetation management burning)
- Dynamic grid failure
- Torpedoes (small explosive charges placed on the track to warn train operators of
  upcoming track hazards)
- Flares
- Wheel slip
- Journal box failure (hotbox)
- Cracked sump oil ejected into exhaust stream

While several of these factors are directly related to maintenance issues for which the train operator has primary responsibility, most if not all of these factors may be mitigated by removing/treating combustible vegetation for a minimum width of 25-feet from the rail line (Cal-Fire, 1999, p. 49).

However, as previously mentioned MCFD’s history, evolution and development, and MCFD’s contract with Cal-Fire makes MCFD the preeminent wildfire agency in Marin County. This is because the contract specifies that MCFD has primary responsibility for suppression of wildfires in the county’s SRA, regardless of jurisdictional boundaries. The contract also enables MCFD to access Cal-Fire resources directly (and in particular fixed and rotary winged fire suppression aircraft) for any wildfire in or threatening the county’s SRA. As such, MCFD is well equipped to deal with any wildland fire caused by rail operations. Furthermore, given the direct response responsibilities of MCFD, the most likely types of incidents associated with rail traffic (vehicle/train collisions) and MCFD’s response capabilities with regard to vehicle extrication and heavy rescue, MCFD is adequately equipped and staffed.

An obvious way to eliminate the possibility of the issues associated with grade crossings such as collisions and possible derailments is to eliminate the grade crossings by elevating or tunneling the right-of-way above/below the grade crossing. This would also substantially reduce the public’s perceived fear of traffic congestion in the downtown areas due to vehicle traffic stoppage while the train passes by. However, due to SMART’s budget constraints and the
expense of constructing these by-passes, this solution is beyond SMART’s capabilities for the foreseeable future.

In researching the fourth research question, what are the mitigating measures that may be taken to reduce the impact rail related emergency incidents, it became apparent that MCFD has very little power to influence the rail operator’s operations, since the FRA has jurisdiction over their operations (LTK Engineering Services, 2009, p. 6). What jurisdiction MCFD may have is limited to issues related to wildland/vegetation fire mitigation addressed in state law.

However, per the recommendations of NFPA 130, the rail operator should develop “Emergency Procedures” to address the following emergencies:

- Fire or smoke within the system structures (stations, trackways, and support facilities)
- Collisions or derailments involving rail vehicles on the trainway, rail vehicles with privately owned vehicles, and intrusion into the right of way from adjacent roads or properties
- Loss of primary motive power resulting in stalled trains
- Evacuation of passengers from a train to all right-of-way configurations under circumstances where assistance is required
- Passenger panic
- Disabled, stalled, or stopped trains due to adverse personnel/passenger emergency conditions
- Tunnel flooding
Disruption of service due to disasters or dangerous conditions adjacent to the system, such as hazardous material spills on adjacent roads or police activities or pursuits dangerously close to the operational system

Structural collapse or imminent collapse of authority property or adjacent property that threatens safe operation of the system

Hazardous materials accidently or intentionally released into the system

Serious vandalism or criminal acts, including terrorism

First aid or medical care for passengers on trains and in stations

Extreme weather conditions

Earthquake

Any other emergency as determined by the authority having jurisdiction (NFPA, 2010, p. 130-33)

These types of emergencies should be addressed in the FRA required fire safety systems analysis of the SMART system. However, the FRA regulations cited above do not prescribe a methodology for conducting a fire safety systems analysis of rail passenger systems. Any proposed methodology to be used to complete a system and rail car system safety analysis per FRA regulations is required to (Transportation, 2007):

- Identify and prioritize foreseeable fire hazards inherent in the design of the particular set of equipment and the environments in which these operate on a given railroad.

- Analyze the features of each type of passenger car ventilation systems such that these systems will not adversely affect the lethality potential of a fire incident affecting the passenger car.
• Identify components that demonstrate an unacceptable fire risk potential, and/or which can foreseeably lead to an unsafe condition due to overheating.

• Identify any unoccupied train compartments in the rolling stock, which may pose a fire hazard. Analyze the benefit and efficacy of including fire/smoke detection devices in these compartments.

There are several methodologies for conducting this analysis in the literature. For example, as mentioned in the FRA’s Collision Hazard Analysis Guide, “MIL-STD-882 has been used as a model to create Rail System Safety Programs, has been successfully applied to railroad transportation systems, and is an appropriate and useful tool to analyze passenger rail safety issues. For example, the System Safety Plan for Amtrak’s Acela High Speed Rail service included a detailed MIL-STD-882 hazard analysis for the Acela railcars and engines. Additionally, the System Safety Plan included a MIL-STD-882 Operational Hazard Analysis (OHA) for the start-up and integration of the new service. The OHA was conducted using teams consisting of Amtrak operating managers, labor representatives, and FRA staff (Department of Transportation, 2007, p. 7).”

This standard practice was developed to address the management of environmental, safety, and health risks that may be encountered in the development, test, production and disposal of DOD systems. The requirements in this standard are intended to ensure identification and understanding of all known hazards and their associated risks. Consistent with the methodologies previously listed, the objective of the standard is to achieve acceptable mishap risk through a systematic analysis of the hazards associated with each system. The methodology recommended by the standard is summarized below (DOD, 2000, p. 4):
Document the system safety approach; i.e., identify each hazard analysis and mishap risk assessment process used.

Identify hazards through a systematic hazard analysis of system hardware, the environment in which the system is to be used, and the intended use of the system.

Assess the severity and probability of the mishap risk associated with each identified hazard.

Identify mishap risk mitigation alternatives and their effectiveness.

Reduce the mishap risk to an acceptable level through an approach mutually agreeable to all of the stakeholders.

Verify mishap risk reduction and mitigation through appropriate analysis, testing and inspection.

Review the hazards and acceptance of residual mishap risk by the appropriate authority.

Track the hazards, their resolution/closures, and the residual mishap risk.

Given the statutory limitations of MCFD’s ability to influence the operations of the rail service, the mitigating measures to be taken to limit the impact of rail emergencies will be addressed in the system safety plans for which the operator has the responsibility to develop.

Recommendations

As mentioned in the *Railroad Fire Prevention Field Guide*, the most effective means of preventing loss of life, property, natural resources, as well as the disruption of train operations is to take a cooperative approach between the train operators and emergency responders (Department of Forestry and Fire Protection, 1999, p. 2). The ways this cooperation can be
implemented include joint planning meetings, cross-training sessions, joint inspections of rail equipment, notification of train operators of critical fire weather, and fire patrols (Department of Forestry and Fire Protection, 1999, p. 2). These activities are also recommended in the ARPs reviewed as part of this research. As of this writing, this researcher is unaware of any such activities involving MCFD having taken place.

As such, it is recommended that the Marin County Training Officers’ Section of the Marin County Fire Chiefs’ Association incorporate rail operations in their block-training syllabus. In addition, all fire agencies in and adjacent to the “101 Corridor” conduct equipment familiarization training with both rail operators. Part of this training and familiarization should be an evaluation (with the train operator’s maintenance and engineering personnel) of the adequacy of the extrication equipment available to the 1st responders in the 101 corridor, and in particular the four fire agencies through which the right-of-way is routed.

John Williams, CEO of NWP was asked how they would deal with a train derailment. Specifically, he was asked if they have a “wrecker” to right trains that have derailed and overturned. He indicated that the speed the freight trains travel (approximately 25-mph) is such that it is unlikely that a derailed train would overturn. In the case of a derailment, they would send their spare locomotive to pull the derailed train back on to the track. If the train/locomotive overturned, NWP would hire a high capacity portable crane to right the train/locomotive. He indicated that there were several in the San Francisco Bay Area (Williams, personal communication, July, 19, 2012). It is recommended that a list of these cranes be developed and placed in Marin County Sheriff’s Office Dispatch (the emergency services dispatcher for the 101 corridor).
It is recommended that rail operator conform to NFPA 130, and in particular the requirements of Chapter 9 (Emergency Procedures), which the train operators are responsible for developing. It is further recommended that these procedures be integrated with the fire service’s master mutual aid agreement, and Marin County Office of Emergency Services’ (OES) disaster mitigation planning. Similarly, it is recommended that Marin County OES include SMART, NCRA and NWP in their disaster response and mitigation planning.

As part of these activities, emergency responder right-of-way access points need to be identified as part of the system safety analysis. According to John Zanzi, the first draft of this analysis is being prepared by an outside consultant (Zanzi, personal communication, July 18, 2012). It is recommended that these access points and routes be identified and incorporated in the county-wide CAD system.

Also, as previously mentioned, the FRA requires the operator prepare a system and rail car fire safety analysis. As part of the fire service’s familiarization with the rail system, the operators should provide copies of these analyses to the fire service.

In researching rail incidents, it was discovered that the FRA uses milepost markers to identify the location of incidents. Therefore, it is recommended that the aforementioned access points and routes, as well as the assets and critical infrastructure at risk be coordinated and integrated with SMART/NCRA mile post markers. Similarly, it is recommended that dispatch “run-cards” (pre-planned fire and emergency resource allocations and assignments) for grade crossing collisions be developed.

Another finding of the research previously mentioned was the lack of detail regarding fire incidents involving rail. One reason for this is that rail operations typically cross several jurisdictions, if not whole states. Also, there are many records management systems used by the
fire service. As such, it is recommended that a fire reporting protocol be developed in cooperation with SMART and NWP for the entire line (not just Marin County’s portion). In this way, the operators and the fire service will better be able to spot possible trends and hence develop appropriate mitigating measures.

The research also revealed that not much is known about PG&E’s natural gas distribution network. Much of this network is within very close proximity to the rail-right-of-way. Although the pipelines are buried, PG&E is unsure of the depth of cover. Also of even more concern, are the 113 valves adjacent to the right-of-way. It is recommended that a survey of these valves be conducted to determine if they are buried or above ground, and if above ground what if any impact protection they have. The survey should also include their specific locations to incorporate them into CAD.

Finally, Dr. Zicherman mentioned that the fire service has been well represented at the NFPA 130 Technical Committee meetings. Dr. Zicherman indicated during these meetings over the past several years, the fire service has repeatedly asked that for “heavy” DMUs, “soft spots” incorporated in to the exterior of the rail cars to expedite extrication and rescue activities on overturned rail cars (see Figure 7, Appendix A). The soft spots would be marked areas on the exterior of the vehicle where the gage/thickness of the exterior skin is thinner (Zicherman, Personal Communication, July 2, 2012). Therefore, it is recommended that SMART contact the rail car builder and determine if these soft spots can be incorporated in the design.
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Appendix A
ASSETS AT RISK

Figure 4
SOIL LIQUEFACTION

Figure 5
Figure 6: Shake Intensity Map.
Figure 7
Appendix B
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