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The goal of this program is to develop an informational video for firefighters. The video covers pertinent and valuable information firefighters need to respond to a call involving the railroad quickly, efficiently, and safely.

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METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in)	=	2.5 centimeters (cm)
1 foot (ft)	=	30 centimeters (cm)
1 yard (yd)	=	0.9 meter (m)
1 mile (mi)	=	1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2)	=	6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2)	=	0.09 square meter (m^2)
1 square yard (sq yd, yd^2)	=	0.8 square meter (m^2)
1 square mile (sq mi, mi^2)	=	2.6 square kilometers (km^2)
1 acre = 0.4 hectare (he)	=	4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz)	=	28 grams (gm)
1 pound (lb)	=	0.45 kilogram (kg)
1 short ton = 2,000 pounds (lb)	=	0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp)	=	5 milliliters (ml)
1 tablespoon (tbsp)	=	15 milliliters (ml)
1 fluid ounce (fl oz)	=	30 milliliters (ml)
1 cup (c)	=	0.24 liter (l)
1 pint (pt)	=	0.47 liter (l)
1 quart (qt)	=	0.96 liter (l)
1 gallon (gal)	=	3.8 liters (l)
1 cubic foot (cu ft, ft^3)	=	0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3)	=	0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

[(x-32)(5/9)] °F = y °C

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm)	=	0.04 inch (in)
1 centimeter (cm)	=	0.4 inch (in)
1 meter (m)	=	3.3 feet (ft)
1 meter (m)	=	1.1 yards (yd)
1 kilometer (km)	=	0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2)	=	0.16 square inch (sq in, in^2)
1 square meter (m^2)	=	1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2)	=	0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2)	=	1 hectare (ha) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gm)	=	0.036 ounce (oz)
1 kilogram (kg)	=	2.2 pounds (lb)
1 tonne (t)	=	1,000 kilograms (kg)
	=	1.1 short tons

VOLUME (APPROXIMATE)

1 milliliter (ml)	=	0.03 fluid ounce (fl oz)
1 liter (l)	=	2.1 pints (pt)
1 liter (l)	=	1.06 quarts (qt)
1 liter (l)	=	0.26 gallon (gal)
1 cubic meter (m^3)	=	36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3)	=	1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

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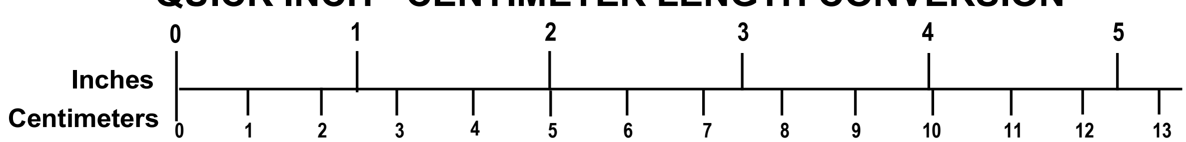
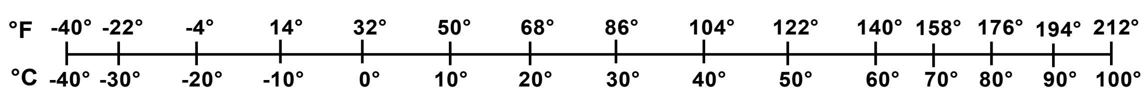


QUICK FAHRENHEIT - CELSIUS TEMPERATURE CONVERSIO



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Railroads are a relatively safe medium of transportation. However, this infrequency, while desirable, has the side effect of limiting the exposure fire rescue crews have to locomotives and train accidents. Most first responders will spend their whole careers never setting foot on a locomotive, much less responding to a train accident. First responders and fire rescue personnel are not afforded an opportunity to interact with locomotives, to study them and to put fire rescue techniques into practice. When an accident occurs, the impact is much more severe than a typical motor vehicle accident and has the potential to easily overwhelm first responders. As such, preparatory trainings are critical to ensure the effective and safe response to the incident.

Most current trainings for fire rescue personnel with respect to trains can be divided into two categories: hazmat trainings focusing on hazardous materials carried as freight and passenger rescue trainings conducted by Amtrak or local commuter railroads. Locomotive rescue training is lacking, which is important because responding crews do not know how to help in rescue operations and in avoiding potential hazards. The Federal Railroad Administration acknowledges this gap and sponsored the previous Locomotive Emergency Response Training (LERT) Phase I and this Phase II work.

To develop LERT, QinetiQ North America (QNA) conducted initial research to pool knowledge from various sources, including railroad personnel, locomotive manufacturers, fire rescue experts, and rescue tool manufacturers to develop an initial version of the training. This initial version was then piloted at six fire departments representing various sizes and capabilities from across the country. From these pilots, several lessons were learned to improve the content and delivery of the training. One of the most significant was the lack of technical information pertaining to locomotive construction and the ability of firefighting tools to create egress points in the superstructure. The research team asked: Which rescue tools should be used? Where should they be used? What was the easiest point to gain access? Would a hydraulic cutter be able to cut through the cross beams in the roof?

To provide comprehensive information for the training, these and similar questions have been answered. Initially, QNA contacted rescue tool manufacturers and locomotive experts to obtain information regarding rescue tool capabilities and the potential efficacy of these tools on locomotive cabs. QNA received conflicting responses, and as inquiries progressed, it became increasingly evident that concrete information was not available. Besides not knowing what would work, what would not work was also not clear. In addition, several concepts, such as the supposed inability of a Halligan bar to break a locomotive windshield, were commonly held but not validated or substantiated. To shed some clarity on the subject using empirical information, researchers decided to conduct experiments with rescue tools on actual locomotives. They conducted experiments involving rescue tool manufacturers and fire rescue personnel on pre-1970 GP-35 locomotives and incorporated lessons learned into the training. They put these lessons into a PowerPoint presentation shown to emergency responders. The purpose of this effort was to turn the PowerPoint presentation into video format.

1. Introduction

In the event of a train accident, proper training of emergency responders is essential to safely and effectively respond to the situation. While there are several existing programs that address training with respect to passenger trains and hazardous materials, trainings focused on rescuing crew members trapped within a locomotive cab are limited. To help address this need, the Federal Railroad Administration (FRA) sponsored QinetiQ North America (QNA) to develop the *Locomotive Emergency Response Operations* Training Video in 2004. FRA and the National Fire Academy (NFA) distributed this video to fire departments. The training video was well received; over 20,000 copies were distributed and requests for a more detailed, classroom course were soon forthcoming. In October 2010, FRA engaged the services of QNA to develop this more comprehensive training.

1.1 Background

Railroads are a relatively safe mode of transportation. In the last 10 years, there have been a total of 6,422 train accidents resulting in 33 deaths and 913 injuries in the U.S. Of these 6,422 train accidents, 419 were collisions, including 90 on mainline track.[1] When compared to the 24,474 motor vehicle deaths that occurred in just 2009 alone, this number seems very small.[2] Because train accidents are less common than highway accidents and because many jurisdictions do not have rail lines, fire rescue crews have limited exposure to locomotives and train accidents. Most first responders will spend their whole careers never setting foot on a locomotive, much less responding to a train accident. First responders and fire rescue personnel are not afforded an opportunity to interact with locomotives, to study them or to put fire rescue techniques into practice. When an accident occurs, the impact is much more severe than a typical motor vehicle accident and has the potential to easily overwhelm first responders. As such, preparatory trainings are critical to ensure the effective and safe response to the incident.

Most current trainings for fire rescue personnel with respect to rail can be divided into two categories: hazmat training focused on hazardous materials and passenger rescue training conducted by Amtrak or local commuter railroads. Locomotive rescue training is lacking. This gap is important because responding crews are not equipped with the prerequisite knowledge to help them in rescue operations and in avoiding potential hazards. FRA acknowledged his gap and saw the need to remedy it.

1.2 Methodology

The development of the training program consisted of five major steps: 1) develop a database on locomotive technical details, rail operations, and the associated challenges of rescue operations associated with locomotive emergencies; 2) identify the learning goals of the training, i.e., the skills and knowledge to be imparted to the first responders; 3) identify the format and layout of the training; 4) develop the actual training; and 5) pilot the training with fire departments to obtain feedback on the comprehensiveness and delivery of the training.

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[1] http://safetydata.fra.dot.gov/officeofsafety/publicsite/Query/tenyr1a.aspx

[2] http://www-fars.nhtsa.dot.gov/Main/index.aspx

Figure 1 describes the training development process.

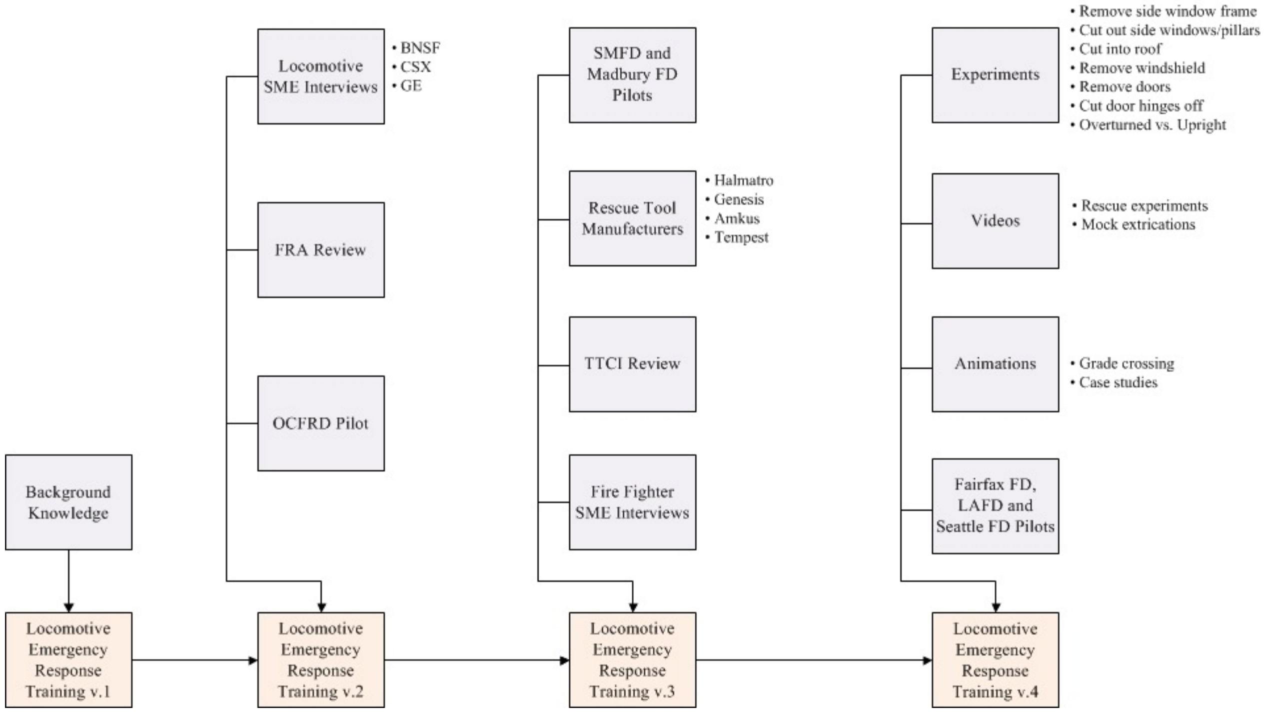

Figure 1: Project Development Flow Chart

1.3 Knowledge Base and Learning Requirements

To gather the requisite knowledge to support the development of the course, the research team pooled various information sources. Initially, NTSB accident investigation reports were obtained and analyzed to determine the dynamics of a locomotive accident and associated challenges encountered during the rescue operations. The reports were also helpful in developing case studies for the course content. While several NTSB accident reports were analyzed, the following were most useful and included in the course content:

- Collision of Union Pacific train with BNSF train in Macdona, Texas, on June 28, 2004
- Collision of three Union Pacific Trains in Pacific, Missouri, on Dec 13 2001
- Collision and Derailment of two CN Trains in Anding, Mississippi, on July10, 2005
- CSX derailment and fire in Baltimore, Maryland, on July 18, 2001
- Collision of two Union Pacific trains in Carrizozo, New Mexico, on Feb 21 2004
- Collision of two Union Pacific trains at Bertram, California, on Nov 10, 2007
- Collision of two Canadian National trains at Clarkston, Michigan, on Nov 15, 2001
- Collision between two BNSF rains near Gunter, Texas, on May 19, 2004

- Collision of Union Pacific Railroad Train with BNSF train in Macdona, Texas, on June 28, 2004

Railroad personnel, locomotive manufacturers, fire rescue experts and other subject matter experts were also queried for information. These individuals contributed information regarding locomotive technical data, such as the type of materials used in construction, railroad operational data pertinent to first responders, lessons learned from past accidents or training efforts, and other relevant information. Table 1 outlines the key individuals contacted.

Table 1: Contacts

Agency	Individual(s)	Date of Contact	Key Discussion Points
EMD	Harvey Boyd	Aug–Sept 2010	Obtained technical information on internal locomotive structures.
GE	David Watson	Aug–Dec 2010	Obtained technical information on internal locomotive structures.
Oriskany Independent Fire & Hose Company (NY)	Chief Jeffrey J. Midlam	Oct 2010	Obtained feedback on program content and delivery methods. Discussed locomotive emergency response issues from an emergency responder's perspective. Discussed types of rescue tools being used by local departments.
CSX Transportation	Robert Rohauer *Operation Lifesaver*	2010–2012	Reviewed Operation Lifesaver training program and lessons learned relating to training emergency responders. Reviewed training program. Discussed emergency rescue operations from railroad perspective.
BNSF	Dana Maryott *Director Locomotives*	2010–2012	Discussed emergency rescue operations from railroad perspective. Discussed and conducted emergency extrication experiments. Assisted in obtaining photographs and locomotive technical information for training.
Commonwealth of Massachusetts Department of Fire Services	Mark S. Pare *Deputy Director Massachusetts Firefighting Academy* David P. Loh *Hazmat/WMD Training Group Coordinator Massachusetts Firefighting Academy*	Aug 2011	Obtained feedback on program content and delivery methods. Discussed locomotive emergency response issues from an emergency responder's perspective. Discussed types of rescue tools being used by local departments. Fire department training protocols and preferences. Lessons learned in developing training programs. Also discussed best way to distribute completed training program – focused on using state fire academies.

Agency	Individual(s)	Date of Contact	Key Discussion Points
Northborough Fire Department (MA)	Chief Durgin	Aug 2011	Obtained feedback on program content and delivery methods. Discussed locomotive emergency response issues from an emergency responder's perspective. Discussed types of rescue tools being used by local departments.
Southborough Fire Department (MA)	Chief Mauro	Aug 2011	Obtained feedback on program content and delivery methods. Discussed locomotive emergency response issues from an emergency responder's perspective. Discussed types of rescue tools being used by local departments.
Lincoln Fire Department (MA)	Chief Arthur Cotoni	Aug 2011	Obtained feedback on program content and delivery methods. Discussed locomotive emergency response issues from an emergency responder's perspective. Discussed types of rescue tools being used by local departments.
Concord Fire Department (MA)	Capt. David Curran	Aug 2011	Obtained feedback on program content and delivery methods. Discussed locomotive emergency response issues from an emergency responder's perspective. Discussed types of rescue tools being used by local departments. Identified experiments that he would like to see conducted on a locomotive. Suggested that handout components would be helpful to the training program.
Natick Fire Department (MA)	Capt. Eugene Rothman	Sept 2011	Obtained feedback on program content and delivery methods. Discussed locomotive emergency response issues from an emergency responder's perspective. Discussed types of rescue tools being used by local departments.
Newton Fire Department (MA)	Chief Paul Chagnon	Sept 2011	Obtained feedback on program content and delivery methods. Discussed locomotive emergency response issues from an emergency responder's perspective. Discussed types of rescue tools being used by local departments.
Springfield Fire Department (MI)	Chief Oaks	Mar 2011	Discussed Clarkson, MI, train accident; the difficulties they faced during rescue operations and lessons learned.

Agency	Individual(s)	Date of Contact	Key Discussion Points
Orange County Fire Rescue Department Fire Operations Division (FL)	Chief Jon M. Haskett	Mar 2011	In depth discussion on rescue operations and tools. Obtained feedback on program content and delivery methods.
Belmont Fire Department (MA)	Lt. David Toomey	April 2011	In depth discussion on rescue operations and tools. Obtained feedback on program content and delivery methods.
NTSB	Richard M. Downs *Mechanical Engineer (Crashworthiness)*	April 2011	Reviewed training program. Discussed past locomotive accidents and case studies. Discussed and conducted emergency extrication experiments.
TTCI	Terrence O. Terrill *Manager - Safety, Health, Environmental, & Emergency Services* Duane E. Otter *Principal Engineer* Leland L. Lile *Fire Chief,*	July 2011	Reviewed training program and discussed extrication experiments. Discussed lessons learned by TTCI relating to training emergency responders.
Pan Am Railways	David Nagy *Executive VP of Safety & Security*	2011–2012	Reviewed training program. Discussed emergency rescue operations from railroad perspective. Discussed and conducted emergency extrication experiments. Assisted in obtaining photographs and locomotive technical information for training.
Volpe National Transportation Systems Center	David Tyrell *Senior Engineer*	July 2011	Obtained information relating to locomotive accidents, potential case studies, and locomotive technical information.
FRA	Les Fiorenzo *Regional Administrator*	Aug 2012	Obtained information relating to track structures and railroad operations.
FRA	Lisa Matsinger *HazMat Specialist*	Sept 2012	Reviewed training program. Discussed past locomotive accidents and case studies. Discussed and conducted emergency extrication experiments.
NTSB	Muhamed A. El-Zoghbi *Accident Investigator*	Sept 2012	Reviewed training program. Discussed past locomotive accidents and case studies. Discussed and conducted

Agency	Individual(s)	Date of Contact	Key Discussion Points
			emergency extrication experiments.
Los Angeles Fire Department (CA)	Captain Chris Cooper	Jan 2013	Discussed train Chatsworth, CA, accident, the difficulties they faced during rescue operations, and lessons learned.

1.4 Extrication Experiments

One of the challenges involved in developing this program was the lack of knowledge with respect to the tools and techniques that should be utilized in locomotive rescue operations. In discussions with first responders, one of the most significant topics raised was the lack of technical information regarding the ability of rescue tools to create egress points in the superstructure. The research team asked: Which rescue tools should be used? Where should they be used? What was the easiest point to gain access? Would a hydraulic cutter be able to cut through the cross beams in the roof?

To provide comprehensive information for the training, these and similar questions needed to be answered. Initially, rescue tool manufacturers and locomotive experts were contacted to obtain information regarding rescue tool capabilities and their potential efficacy on locomotive cabs. Conflicting responses were obtained and as inquires progressed; it became increasingly evident that concrete information was not available. In addition, several concepts, such as the supposed inability of a Halligan bar to break a locomotive windshield, were commonly held but not validated or substantiated. To gain clarity on the subject using empirical information, researchers conducted experiments with rescue tools on actual locomotives.

For this, QNA conducted structural analysis of locomotive cabs and experiments with rescue tools on locomotives. The locomotives were two older, 1960s GP-35s donated by Pan Am Railways, tested over 2 days at Pan Am's Waterville, Maine, yard. The experiments involved fire rescue personnel and rescue tool manufacturers. Tools ranging from a standard Halligan bar to specialized tools such as hydraulic cutters were tested for effectiveness, speed, and safety. Researchers contacted the four rescue tool manufacturers listed in Table 2. Based on the popularity of the tool and the willingness of the tool manufacturer to participate, AMKUS was selected as a partner for the extrication experiments.

Table 2: Rescue Tool Manufactures

Tool Manufacturer
Halmatro
Hurst
Genesis
AMKUS

First-day experiments involved an upright locomotive, as shown in Figure 2, and exploratory activities to determine the “rescue combination” of tool, technique, and location on the cab that provided the best options for egress. Rescue combinations were judged by the following criteria:

1. *Speed of entry:* The time required from when rescue personnel begin the operation until the time they gain access to the cab interior. A highly successful combination will take less than 5 minutes.
2. *Number of personnel required:* The number of individuals required to successfully and safely execute the operation. This includes individuals in supporting roles. The fewer number of personnel required the better.
3. *Portability:* A portable combination is one in which a small number of personnel can carry all of the required equipment by hand to the incident scene. Less portable combinations would require vehicular support.
4. *Size of egress port:* The size of the opening made in the structure. Previous research has indicated that the minimum size of the egress port should be 2 feet by 2 feet. This size allows enough room for a body board to pass through, with additional space for the rescue personnel.
5. *Risk to victims and rescue personnel:* Ideally, no further harm should come to the victims and at the very minimum, the method should be survivable.
6. *Risk to rescue personnel:* This criterion is more difficult to define because all rescue operations present risk and hazards to rescue personnel. However, any rescue combination that presents an obviously unacceptable level of risk to rescue personnel will not be considered as viable.

Figure 2: GP-35 Upright Demonstration

Researchers developed a testing plan with input from fire rescue professionals and rescue tool manufacturers for this first day. The plan covered various tools and egress locations on the locomotive cab. In terms of egress points, the roof, back door (behind the engineer), side windows, and windshield were all considered viable egress locations. The tests listed below provide an overview of the testing plan:

1. Gain access through roof using reciprocating saw , hydraulic cutter (see Figure 3) and/or hydraulic spreader (see Figure 4).
2. Gain access through roof, using K-12 saw.
3. Gain access through front windshield using Halligan tool (see Figure 5), pick head ax, circular saw with carbide tip blade.
4. Cut out window frame with reciprocating saw, air chisel, and rotary saw.
5. Remove gasket around windshield using knife, screwdriver, and hammer.
6. Use hydraulic spreader (see Figure 4) to enlarge door opening and remove door.
7. Use hydraulic cutter to cut door hinges to remove door (Figure 3).
8. Remove side windows with Halligan tool/axe and use hydraulic ram (see Figure 6) to enlarge opening.

Figure 3: Hydraulic Cutter

Figure 4: Hydraulic Spreader

Figure 5: Halligan Tool

Figure 6: Hydraulic Ram

One the second day of testing, the knowledge gained during day one was utilized to record instructional video for the training. On day two the locomotive was positioned on its side, with the conductor's side down, to simulate a more realistic post-accident position (see Figure 7).

Figure 7: GP-35 Side Demonstration

These two GP-35 locomotives represent an older generation of locomotive; their usage was largely restricted to smaller regional railroads or serve as yard pushers. Newer locomotives with stronger build materials and more resistant internal structures are used for mainline travel by Class I railroads. It is important to conduct extrication testing on these locomotive cabs to obtain more comprehensive and realistic information to inform rescue efforts. Unfortunately, researchers were unable to obtain donated, new locomotives in this effort. However, they were able to conduct some initial testing, as outlined in Table 3, on an SD-70 cab shell located at QNA's Fitchburg, Massachusetts, facility. The outcomes and lessons learned in all of the extrication training are discussed in Section 3.

Table 3: Experiments on SD-70 Cab Shell

Task #	Task	Description	Tools
1	Door Removal	Cut door hinges.	Cutter
2	Windshield Access	Attempt to break windshield.	Halligan, Axe
3	Roof Opening	Cut roof cross bracing.	Cutter, Spreaders
4	Enlarge Side Window	Cut the side paneling on locomotive and enlarge using ram.	Cutter, Ram
5	Enlarge Rear Door Opening	Enlarge the opening to allow for backboard removal.	Spreaders, Ram

Figure 8 and Figure 9 show demonstrations on a SD-70, a newer locomotive. In Figure 8, a hole in the roof is being made with a power drill. Figure 9 shows the locomotive window frame after removal of the glass.

Figure 8: SD-70 Roof Access Demonstration

Figure 9: SD-70 Windshield Demonstration

The development of the LERT training program consisted of the following major steps:

(1) Develop a database of knowledge on locomotive technical details, rail operations, and the associated challenges of rescue operations associated with locomotive emergency response.

(2) Identify the learning goals of the training, i.e., the skills and knowledge to be imparted to the first responders.

(3) Identify the format and layout of the training.

(4) Develop the actual training.

(5) Pilot the training with fire departments to obtain feedback on the comprehensiveness and delivery of the training. A similar approach will be utilized for RSLET and is outlined in the work plan section of this report.

1.5 Knowledge Base and Learning Requirements

Three high-level learning objectives were formed at the start of this effort. They are:

1. *Locate and access incident scene:* The first responders should be able to locate the incident scene and develop safe and effective strategies to access the incident.
2. *Access interior of locomotive to rescue personnel:* Once gaining access to the incident, the first responders should be able to extricate any trapped crew members from the locomotive.
3. *Maintain scene safety:* The first responders should be well-versed with the hazards present at the incident scene and be able to maintain the safety of themselves, any victims, and the general public.

Based on the research conducted as described in section 1.4 specific learning objectives were developed to address the aforementioned high-level learning objectives. Table 4 lists and relates these specific learning objectives to the high level learning objectives.

Table 4: Specific Learning Objectives

Specific Learning Objective	Locate Scene	Rescue Crew	Scene Safety
Explain the importance of knowing about locomotive accidents and rescue techniques.	X	X	X
Discuss why preplanning for such incidents is essential.	X	X	X
Visually classify a locomotive, i.e., passenger, freight, diesel, electric, etc.		X	X
Identify the differences between rail locomotives and passenger vehicles.	X	X	X
Recognize and recall basic rail infrastructure such as switch, main track, siding, etc.	X		X
Identify possible points of failure and locations where rail accidents are most likely to occur.	X		X
Predict the locations in their territory where locomotive accidents are	X		

Specific Learning Objective	Locate Scene	Rescue Crew	Scene Safety
most likely to occur.			
Discuss basic locomotive structural components in terms of their location, layouts, and characteristics, such as:		X	X
Engine			
Cab			
Fuel tank			
Electric wiring conduits			
Body construction materials and thicknesses			
Windshield thickness and glazing characteristics			
Predict the number of crew and their locations within a locomotive cab based on the type of locomotive.		X	
Describe the basics of rail operations and control, e.g., short lines, track classes, etc.			X
Recognize that dispatch/rail right-of-way control authority and the locomotive operator may be different entities.			X
Identify the rail right-of-way owner and operating railroads in their territory.	X		X
Locate emergency contact information for and communicate with dispatch and railway officials to determine and/or report incident location and access.	X		X
Interpret railroad reference points and railway maps.	X		
Demonstrate the ability to gain access to the interior of the locomotive, including:		X	X
Understanding the structure of a locomotive			
Identifying possible access points			
Identifying the difficulties involved in accessing interior of locomotive			
Recalling methods to overcome difficulties			
Analyzing alternatives to determine action plan with likelihood of greatest success			
Selecting the proper tools and methods for gaining access			

Specific Learning Objective	Locate Scene	Rescue Crew	Scene Safety
Demonstrate the ability to extricate and rescue survivors from the interior of the locomotive by applying previous knowledge of extrication and rescue methods to rail rescue operations.		X	
Communicate with rail authority to confirm that all rail operations have ceased on right of way.			X
Demonstrate proper flagging techniques and flagger positioning relative to incident scene			X
Identify and avoid sources of potential electric shock hazards such as third rail, electrical catenaries, and electrical conduits.			X
Implement tools or steps required to negate any electrical hazards.			X
Predict and avoid potential scene destabilization hazards, such as mud slides and locomotive destabilization.			X
Assess scene for additional safety hazards such as hazardous materials, spilled fuel, and fire threats.			X
Demonstrate ability to determine when and how control of incident scene will be transitioned to operating railroad or other authorized entity.			X

1.6 Locomotive Experiments

Testing was conducted on two GP-35 locomotives donated by Pan Am Railways (Figure 10). Two fire rescue crews from Waterville Fire Rescue (WFR) participated in the testing. WFR also supplied a tower truck, a rescue Vehicle, and all standard fire rescue tools utilized by firefighters, with the exception of hydraulic tools. AMKUS Rescue Systems supplied hydraulic tools, along with personnel to operate them. The hydraulic tools included a cutter, spreader, push-pull ram, and associated peripherals such as a hydraulic pump, hoses, etc.

The experiments revealed the following:

1. The roof provided a viable option of egress. The reciprocating saw, equipped with regular metal cutting blade, could cut through the roof material with relative ease. However, items such as compressed air pipes or support beams slowed down the process. These obstacles also presented potentials hazards, i.e., compressed air or live electricity, so caution must be exercised in cutting through the roof. After several trials and different combinations of tools and techniques, a method was developed that allowed access within 5 minutes. The method is included in the training video. Figures 11–15 below depict this method.

Figure 10: Punching Hole Using Halligan Tool

Figure 11: Cutting Opening into Roof Using Sawzall

Figure 12: Using Hydraulic Spreader to Peel Back Roof

Figure 13: Cutting through Roof Components Using Sawzall

Figure 14: Final Roof Egress Point

2. The K-12 blade was the quickest and easiest way to get through the roof. However, its use is strongly discouraged because when cutting the insulation material inside the cab structure (see Figure 16), the amount of smoke generated would likely not be survivable for the cab occupants. Also, the many sparks produced by the K-12 may ignite any spilled fuel or other flammable materials that may have been released during the accident. The use of a torch or plasma cutter is not recommended for the same reasons.

Figure 15: Roof Components, Including Insulation

3. The Halligan tool and axe could break through the windshield of the locomotive within 1 minute. This was surprising, as the commonly held belief among railroad professionals is that the FRA Type II locomotive windshields cannot be easily broken.
4. Both the reciprocating saw and air chisel could remove the gasket around the windshield. However, the process was slower than breaking through the windshield using a Halligan tool.
5. It was possible to remove the gasket holding the windshield in place using a knife, screwdriver, and hammer. Even though the process did not take more than 5 minutes, it was very labor-intensive and required much energy by the rescuer. Again the preferred method was to break through the windshield.
6. The hydraulic spreader could enlarge the door opening; however, it was not very adept at removing the door. If the doorway is crushed in an accident, it can be enlarged using the spreader or hydraulic ram.
7. The hydraulic cutter could cut through the door hinges very quickly and easily. However, the position of the rescuer to complete this operation may prove to be too hazardous for practical use.
8. The side windows were easily removed using the Halligan tool or axe. While the opening produced by the removal of the window panes was sufficient, a hydraulic ram could

easily enlarge the opening if needed. Due to the height of the locomotive, the side windows, while easy to remove, may be difficult to reach. This method applies if the locomotive is upright or overturned.

1.7 Training Materials

The final training materials developed include a 2½-hour PowerPoint presentation, entitled *Locomotive Emergency Response Training*, instructor's notes, and a test. The test can be utilized by fire departments for post-training evaluation if they desire. Three animations and 15 extrication videos were also developed for the PowerPoint presentation. Most firefighters are visual learners, so an effort was made to present as much material as possible in a visual rather than auditory format.

1.8 Objectives

The objective of this project was to create an informational video based on the developed PowerPoint presentation of previous work.

1.9 Overall Approach

With input from stakeholders, the team developed an informational video to provide valuable information to law enforcement when responding to a call involving a railroad.

1.10 Scope

The scope of this project includes the development of a short informational video to be used in conjunction with other methods of training for firefighters when responding to railroad emergencies.

1.11 Organization of the Report

Section 1 consists of the introduction, background, description of previous work on the LERT effort, as well as the objective, overall approach, and scope of the study.

Section 2 of this report consists of the informational video script.

Section 3 contains the conclusions.

2. Develop Informational Video

2.1 Video

The final informational video was delivered to FRA and posted on its website at Law Enforcement/First Responders Resources | FRA (dot.gov).

3. Conclusion

While the training program has been systematically developed and is based on empirical and experiential data, its success in educating emergency responders will depend on the subsequent deployment strategy. Without a well-developed and effective deployment strategy, the training impact will fall short of achieving the target. An added challenge is the fact that the content provided in the training is unique and highly specialized, and may be difficult to comprehend without first-hand experience. To properly conduct the training, a trainer (at the fire department level) must be trained by a knowledgeable and properly versed master trainer. The goal of the deployment strategy is to reach as many fire departments as possible in a cost-effective manner while transmitting the information faithfully and comprehensively. This video is a version of the training program.

Abbreviations and Acronyms

BLE	Brotherhood of Locomotive Engineers
CFR	Code of Federal Regulations
EDT	Emergency Dispatcher Training
FMVSS	Federal Motor Vehicle Safety Standards
MBTA	Massachusetts Bay Transit Authority
OLI	Operation Lifesaver, Inc.
OSHA	Occupational Safety and Health Administration
UTU	United Transportation Union