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# **FIRE SAFETY ANALYSIS (FSA)**

**Property Identification:**

**Liquid Propane Gas Transfer Facility  
42 Westboro Road  
Grafton, MA 01536**

**EBI Project No. 68150018**

**November 2, 2016**

**Prepared for:**

**Grafton and Upton Railroad  
42 Westboro Road  
Grafton, MA 01536**

**Prepared by:**

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## **1.0 INTRODUCTION**

EnviroBusiness, Inc. (d/b/a EBI Consulting) (EBI) has prepared this Fire Safety Analysis (FSA) to address the fire safety analysis requirements outlined in 502 CMR 5.00. The Grafton and Upton Railroad (G&UR) has designed and partially constructed a Liquid Propane Gas Transfer Facility (LPGTF) at their property located at 42 Westboro Road in Grafton, Massachusetts. This FSA discusses fire safety requirements, facility specific information, applicable guidance, codes and standards to which the LPGTF was designed and constructed, how the LPGTF will be operated and the procedures to be followed in the event of an emergency. The LPGTF has been designed and will be operated in full conformance with NFPA 58 – Liquefied Petroleum Gas Code, 2011 Edition requirements. Additionally, guidance documents adopted by the Petroleum Education Research Council (PERC) and the National Propane Gas Association (NPGA) for the training of operators and for plant operation and maintenance (O&M) have been incorporated into the OSHA Process Safety Management (PSM) Plan prepared specifically for the LPGTF.

### **1.1 Meetings with the State Fire Marshall Office and Grafton Fire Department (GFD)**

Several project planning meetings have been held at the Grafton, MA Fire Department (GFD) located on 26 Upton Street in Grafton, MA and at the G&UR LPGTF location on 42 Westboro Road in Grafton, MA to discuss the Massachusetts fire protection requirements as they apply to LPGTF and information to be included in the FSA. The project team met on the dates listed below to address comments and fire safety concerns expressed by the team members. The meetings were very productive and served to address comments and concerns expressed by the GFD and State Fire Marshal's Office including but not limited to LPG truck vehicle access, water availability for firefighting and facility water suppression systems (water canons), site security and access, facility access for GFD fire trucks/vehicles, the location and type of propane sensors, notification of area businesses with GFD Welding Permits, training for LPGTF operations personnel and GFD first responders and emergency evacuation planning.

The team met on the following dates and locations:

- April 22, 2015 at the GFD
- July 17, 2015 at the GFD;
- September 17, 2015 at the GFD;
- October 15, 2015 at the G&UR LPGTF;
- January 7, 2016 at the G&UR LPGTF;
- January 21, 2016 at the GFD;
- August 16, 2016, and
- October 21, 2016.

The following parties attended the meetings:

- Michael E. Gauthier, Fire Chief, Grafton, MA;
- Stephen Charest, Assistant Chief, Grafton, MA;
- Michael Mills, Deputy Chief, Grafton, MA;
- Jacob Nunnemacher, Office of the State Fire Marshall, Stow, MA;
- Doug Willardson, Assistant Town Administrator, Grafton, MA (on July 17, 2015 and January 21, 2016);
- Robert Berger, Inspector of Buildings, Grafton, MA (on July 17, 2015);
- Stan Gordon and Dave Swirk, Grafton and Upton Railroad, Grafton, MA;
- Troy Philips (Rhode Island Fire Academy and Fire Captain, Oakland Mapleville Fire Department (on August 16, 2016 only),
- Robert Ceppi (MPE, Inc.); and
- Dr. Robert Palermo, EBI Consulting, Burlington, MA.

## **1.2 Submission of Supporting Documents**

At the last meeting on August 16, 2016 held at the GFD at 4:30 PM it was agreed by all parties that the G&UR LPGTF would provide copies of the supporting documents when completed and would further coordinate training as required with the GFD and Grafton emergency responders. Prior to the introduction of propane at the LPGTF the following documents will be made available to the GFD for review and comment once the G&UR LPGTF employees have been hired and the LPGTF construction and equipment installations are complete:

- OSHA Process Safety Management (PSM) Plan;
- EPA Risk Management Plan (RMP) Online Narrative;
- OSHA Emergency Action Plan (EAP);
- OSHA Fire Prevention Plan (FPP);
- OSHA HAZCOM/GHS Written Program;
- OSHA Control of Hazardous Energy Sources (LOTO) Written Program;
- OSHA Personal Protective Equipment (PPE) Written Program;
- OSHA HAZWOPER Program;
- OSHA Respiratory Protection Program; and
- OSHA Hot Work (HW) Programs.

The G&UR recognizes that the GFD will be the principal fire department responding to any incident/emergency that might occur at the subject facility and as discussed at the FSA meetings the G&UR agrees to include the FD responders as well as other Grafton

emergency responders (e.g., Police, DPW, Emergency Management, etc.) in the training that will be conducted to address the Occupational Safety and Health Administration, (OSHA) Process Safety Management (PSM) Plan as well as other applicable OSHA requirements which apply to the facility operations.

We plan on conducting the following training after the LPGTF construction and equipment installation are complete and when the employees have been hired (who are required to attend the training) and are on board and prior to operational start-up of the LPGTF:

- GFD Familiarity Training of the LPGTF (e.g., safety systems, fire protection systems, access and egress, emergency procedures, etc.);
- Process Safety Management (PSM);
- Hazard Communication/Global Harmonization System (HAZCOM/GHS);
- Emergency Action Plan (EAP);
- Fire Prevention Plan (FPP);
- Hazardous Waste Operations and Emergency Response (HAZWOPER);
- Personal Protective Equipment (PPE);
- The Control of Hazardous Energy (LOTO);
- Respiratory Protection; and
- Hot Work Programs.

The G&UR will as we have discussed coordinate this training with the GFD and with other local responders (e.g., GPD, Grafton Emergency Management, Grafton Medical Service Provider Med-Star, etc.) accordingly so that they can attend and participate in the above referenced training programs. It does not make sense at this point in time to conduct the training until the construction and equipment installations at the LPGTF are complete and a qualified plant manager and employees have been hired to operate the facility.

### **1.3 Contents of Fire Safety Analysis**

The purpose of the FSA is to describe the current site conditions and fire safety design analysis undertaken by the G&UR for the subject LPGTF. As outlined in 502 CMR 5.00 the Fire Safety Analysis (FSA) includes an engineering evaluation of the following:

1. An analysis of the fire and explosion hazards;
2. An analysis of the emergency relief from the tanks;
3. An analysis of local conditions and exposure to adjacent properties;
4. An analysis of emergency response capabilities of the local fire department; and
5. An analysis of the applicable requirements under the flammable gas codes and standards (NFPA 58 and applicable Massachusetts fire prevention regulations).

The FSA also include a suitability assessment of the tanks' foundation systems as discussed in Section 5.7.

This FSA is organized into the following report sections:

- 1.0 INTRODUCTION;**
- 2.0 FACILITY & AREA DESCRIPTION;**
- 3.0 FIRE SAFETY ANALYSIS;**
- 4.0 APPLICABLE GUIDANCE, CODES & STANDARDS;**
- 5.0 MASSACHUSETTS FIRE PROTECTION REGULATIONS;**
- 6.0 ADEQUACY OF WATER SUPPLY & USE OF WATER CANNONS**
- 7.0 OPERATIONS & MAINTENANCE**
- 8.0 EMERGENCY ACTION PLAN;**
- 9.0 WORK IN PROGRESS;**
- 10.0 LIMITATIONS; and**
- 11.0 REFERENCES.**

#### **1.4 Use of Design Professional and Massachusetts Registered Professional Engineers (PE)**

The design professionals that were retained by the G&UR to support the design and construction of the LPGTF are listed on Table 1 with their respective support roles. The following design professional have been retained to support the design and construction of the LPGTF:

- Theodore Lemoff, PE (Chemical Engineer);
- Robert Ceppi, PE (Fire Protection Engineer);
- Arthur F. Borden, PLS (Professional Land Surveyor);
- Albert P. Hermans, PE (Structural Engineer);
- Richard Pizzi, PE (Civil/Geotechnical Engineer);
- Dr. Robert S. Palermo, PE, LSP (Civil/Environmental Engineer and Licensed Site Professional);
- Rene B. Martinez (Electrical Engineer); and
- John T. Gillon, PE (Transportation Engineer).

## **2.0 FACILITY & AREA DESCRIPTION**

### **2.1 Facility Description**

The G&UR LPGTF is located at 42 Westboro Street in Grafton, MA and occupies approximately 8.61 acres (see Appendix B). The LPGTF was designed and constructed by LPG Ventures located at 9611 E. 53<sup>rd</sup> Street in Raytown, MO. The LPGTF in its current form includes all of the tank conveyance pipework, tank and pipework supports, reinforced concrete piers, reinforced concrete truck loading pad, rail tank unloading racks and access walkway, pumps and valves, and a control room. Four (4) steel horizontal 80,000-gallon aboveground storage tanks (AST) are installed at the LPGTF. When the LPGTF is operational LPG will be transferred from rail cars into the four LPG tanks. Compressors/pumps are utilized to transfer the LPG from the railcars to the horizontal 80,000 gallon tanks during offloading and to transfer the LPG to the truck loading pad to accomplish fuel loading of LPG transfer trucks with a capacity of approximately 9,000 gallons each.

Figure 1 shows the location of the LPG terminal. Figure 2 includes an aerial view of the site and surrounding area. Figure 3 includes a USGS 7.5 Minute Topographic Map of the immediate area surrounding the site. Figure 4 includes the Grafton Assessors Map depicting the distances to surrounding properties and Figure 5 includes the Grafton, MA Street Map. Figure 6 includes a map of occupants potentially impacted by a propane release.

### **2.2 Area Topography**

The LPGTF is located adjacent to a wetland to the east with comparatively lower topographic elevations on site ranging from 350 to 360 feet above sea level (see Figure 3 topographic map and Appendix B Site Plan). The site gradually slopes to the east into the wetland area. A small water course is shown on Figure 3 which hydraulically connects Windel Pond, Pratts Pond and Hayes Pond. The railroad tracks are oriented along the western perimeter of the site. The four ASTs are centrally located on the site at a lower elevation.

### **2.3 Area Land Use**

The Site is situated in a mixed residential and commercial area with homes located around the site with the greatest density to the west and east of the site (see Figure 4). There is an existing building located in the northeast area of the site which is occupied and used by the G&UR for their rail operations, which is labeled #42 Existing Dwelling on the Site Plan (see Appendix B1). Additionally, there is an unoccupied garage located in the northeast areas of the site which is used as the Control Room for the LPGTF and is labeled on the Site Plan as "Existing Garage" (see Appendix B1). There are two other buildings located in the

northwest area of the site which are labeled as “Exist. Bldg.” and “Existing Building” on the Site Plan (see Appendix B1). The building marked Exit. Bldg. is used to store a propane powered forklift, locomotive parts and supplies like motor oil and sand. The forklift is used to unload box cars and to load trucks at the dock.

The locations of the properties surrounding the site are shown on Figure 4 which includes both commercial buildings, residential and public buildings (library and school). The off site receptors distances from the G&UR LPGTF to the noted Figure 4 locations are summarized below and were measured from Google Maps Satellite view and then transferred onto the Town of Grafton Assessor Map for display:

**Offsite Receptor Distances from the G&UR LPGTF**

Grafton Assessors Map #Description	Distance/Direction	
	Feet	Direction
#57 Commercial Building	256	West
North Grafton Public Library	763	Northwest
#48 Residence	471	North
#62 Residence	786	Northwest
#59 Residence	578	East
#93 North Grafton Elementary School	1,515	Southeast
#77 Residence	609	Southeast
#105 Residence	696	South
#39 Residence	517	Southwest
#34 Residence	452	West

**3.0 FIRE SAFETY ANALYSIS**

The principal elements of the FSA required by NFPA 58 are summarized below:

1. Effectiveness of product control measures;
2. Local conditions of hazard within the container site, including congestion within the Site;
3. Exposure to off-site properties and populations and the impact of neighboring industrial activity on the facility;
4. Effectiveness of the local Fire Department that may respond to an emergency within the facility;

5. Requirements for and availability of adequate water supply; and
6. Full compliance with code requirements for existing LP-Gas facilities and corrective actions to be implemented for a proposed facility to address any deficiencies.

The development of a FSA involves a number of steps as shown on Table 2. The FSA requirements are presented in one or more tables and fill-in forms (see Appendix A for FSA completed forms). The tables provide either factual information or calculated results. The fill-in forms specify the NFPA 58 requirements and/or other assessment parameters, and provide two columns, one with a “Yes” column heading and the other with a “No” heading. In some cases either schematic or pictorial representations are provided to clarify a requirement. The fill-in forms require information input, either checking a “Yes” column or a “No” column or writing a numerical value. Also provided are notes under each table or fill-in form to explain conditions, if any, associated with the table or the form or how a calculation is performed for entering data into the form.

### 3.1 Gas Line and Storage Container Safety Features

The LPGTF has been designed and constructed based on current best management practices (BMPs) as discussed in Section 3.0. The facility transfer lines and tanks will be equipped with protective valve devices including Emergency Shut Off Valves (ESV), Backflow Check Valves (BCK), Excess Flow Valves (EFV), Hydrostatic Pressure Relief Valve (PRV) and breakaway protection should a truck accidentally pull away from a truck loading area. The LPGTF uses both automatic and manual ESVs to shut down the LPG flow in the event of an emergency. A brief description of the types of valves used are provided below:

**Positive Shutoff Valve:** Manually operated shutoff valve used to control the flow of propane.

**Backflow Check Valve:** Valve allows flow in one direction only and is used to allow a container to be filled while preventing product from flowing out of the container.

**Excess-Flow Valve:** Valve designed to close when the liquid or vapor passing through it exceeds a prescribed flow rate.

**Internal Valve:** Primary shutoff valve for a container that can be closed remotely, which incorporates an internal excess flow valve with the seat and seat disc located within the container so that they remain in place should external damage occur to the valve.

**Emergency Shutoff Valve:** Shutoff valve incorporating thermal and manual means of closing that also provides for a remote means of closing.

**Hydrostatic Pressure Relief Valve:** Relief valve that is set to open and relieve pressure in a liquid hose or pipe segment between two shutoff valves when the pressure exceeds the setting of the valve.

**Container Pressure Relief Valve:** A type of pressure relief device designed to open and then close to prevent excess internal fluid pressure in a container without releasing the entire contents.

### **3.2 LPG Terminal Staffing and Hours of Operation**

The G&UR LPGTF will be staffed with a full time manager/operator and up to 2-4 additional employees depending upon volume. The facility will operate 24-hours a day 7-days per week. The facility will not operate on holidays but will operate on week days during the heating season. The LPGTF plans are contained in Appendix B1 through B3. Appendix B1 includes the site topographic plan, Appendix B2 includes the facility safety systems plan and Appendix B3 includes the truck loading pad, ASTs, rail car loading racks and truck entrance and exit routes plan.

### **3.3 Site Security and Illumination**

The G&UR LPGTF will be secured with a seven (7) foot galvanized steel mesh security fence around the entire perimeter of the facility (see Appendix B2 Facility Safety System). Access into and out of the facility will be controlled by access gates and will be monitored by the on site operator and/or a remote security monitoring service during all hours of operation. The access gate locations are shown on the Site Plan and include a 30 foot wide entrance gate for the incoming trucks, entrance gates for vehicles along the northern (w/knock box) and southern train tracks along the west perimeter and train gates to accommodate rail car unloading located south of the E-Stop. Video security will also be used and be in place at the facility. Adequate illumination is provided at nighttime to illuminate the storage tanks, pumps and compressors, emergency shut off valves (ESV) and other essential equipment. The security monitoring system will have the ability to remotely shut down the facility by any person on site, remotely on site, remotely off site by employee or monitoring station. The location of the facility lighting is shown on the Site Plan in Appendix B2.

### **3.4 Tank and Pipework Protection**

Equipment exposed to vehicular movement will be protected with guard rails, steel bollards, crash pots or other equal means. The truck loading pad will be fully protected with bollards to prevent any damage to the propane lines and equipment.

### 3.5 Separation Distances from Containers to Buildings and Property Lines

A minimum distance of 100 feet from above ground containers has been maintained to buildings and property lines. The Site Plan in Appendix B1 through B3 indicates that the minimum distances exist.

### 3.6 Assessment of Sources of Ignition and Adjacent Combustible Materials

Minimum distances of 10 ft. are maintained from all combustible materials (grass, weeds, etc.) and 20 feet between containers and tanks containing flammable liquids with a flash point < 200° F. There are no flammable liquids stored on the LPGTF. Methanol may be used at the facility as required to remove water from the AST but will be stored and used in small quantities (e.g., 55-gallon drums) stored away from AST locations. If and when the Methanol is used it will be stored in a separate storage shed which will be electrically grounded and containers used to transfer Methanol from the drums will be electrically bonded from the transfer container to the drums.

### 3.7 Distance to Lower Explosive Limit (LEL) and 1 PSI Over Pressure

The distance from the LPGTF at which the LEL and 1 psi Over Pressure was estimated is based on the RMP\*Comp software modeling as shown below. Based on the RMP\*Comp modeling for a vapor cloud the LEL for propane could be reached in 0.1 miles from the release source and for a vapor cloud explosion 1 psig over pressure could be reached at a distance of 0.3 miles from the source release using a release rate of 5,166 lbs./minute of propane (310,000 lbs. ÷ 60 minutes) as shown below. The RMP\*Comp model was also run with a release rate of 8,000 lbs./minute and similar results were obtained. At 1 psi over pressure partial demolition of a house may occur resulting in serious injury to the occupants and shattering of glass windows causing skin lacerations from the flying glass.

**EPA RMP Comp Modeled Fire Scenarios Release Rate of 5,166 lbs./Minute 1.**

Modeled Fire Condition Scenario	Pounds of Propane Releases (lbs.)	Distance to 1 psig Over Pressure	Distance to Reach LEL/LFL	Atmosphere Stability Class	Air Temp. Degrees F	Wind Speed (mph)
Worst Case	310,000 lbs.	0.5 miles		D	77° F	6.7 mph
Alternate- Vapor Cloud Fire	5,166 lbs./minute		0.1 miles	D	77° F	6.7 mph
Alternate -Vapor Cloud Explosion	5,166 lbs./minute	0.3 miles		D	77° F	6.7 mph

Note: 1. The release rate of 5,166 lbs./minute is based on emptying one 80,000 gallon (gals.) tank over 60-minutes. The 80,000 gals. tank is filled with LPG to 91.39% of its fill volume or 73,113 gals. since the tank

can not be completely filled in order to allow for vapor and liquid expansion. The density of LPG is 4.24 lbs./gals.

It can be concluded from the above that if the worst case scenario occurred at the LPGTF and one complete tank volume was immediately released into the atmosphere (e.g., 73,113 gals. or 310,000 lbs. of propane) the distance where 1 PSI over pressure would be achieved is 0.5 miles. Based on a slower release rate over 60-minutes, the LEL would be reached at 0.1 miles downwind from the facility from the vapor cloud. Based on a slower release rate over 60-minutes, 1 psig over pressure could be reached at 0.3 miles where partial demolition of a house may occur resulting in serious injury to the occupants and shattering of glass windows causing skin lacerations from the flying glass.

### **3.8 Use of Fire Extinguishing Equipment**

Portable, dry chemical fire extinguishers with a minimum capacity of 18 pounds (lbs.) and having a B:C fire rating will be employed at the LPGTF. A fire cannon water suppression system will also be in place at the facility to cool down the tanks in the case of a fire emergency (see Appendix E). The water cannon system utilizes four adjustable water cannons which can be operated by both hands on and remotely from a safe distance since the controls for each individual cannon are wireless. The water cannon locations are shown on the Site Plan in Appendix B2 and have been located to provide sufficient area coverage of the rail cars, ASTs and truck propane loading areas.

### **3.9 Ignition Control Procedures**

Grounding legs and ignition control procedures will be employed during all LGP gas transfers. All electrical connections and lines have been classified for flammable gases and electrical circuits have been adequately protected to prevent an ignition from occurring.

### **3.10 Analysis of Potentially Hazardous Situations from Surroundings and Neighbors**

The closest building structure is 256 feet from the LPGTF tank farm location. The tank farm is also located in a topographic depression which would provide some protection from the heat. The water cannons will, if necessary, be used to immediately cool the tanks and help prevent the pressure relief valves (PRV) from opening at the tanks.

Potentially hazardous situations from the surroundings and neighbors would involve potential business activities which have the potential to provide an ignition source in the event of a propane gas release. The likely ignition sources could include outside propane gas grills in use and businesses which perform outside/outdoor metal welding, cutting and grinding operations or buildings partially open to the outside performing metal welding, cutting and grinding. The following businesses located within a half mile of the G&UR LPGF which have the potential to act as an ignition source include:

1. Operation of the G&UR train engines as they enter and exit the LPGTF;
2. Earthworks located at 108 North Main Street, North Grafton, MA, Telephone No. (774) 696-6796 (easterly approximately 2,252 ft. away)
3. Dana Transport, 88 Westboro Road, Grafton, MA, Telephone No. (508)-839-5000 or 1-800-733-DANA (easterly approximately 2,267 ft. away)
4. Sunshine Sign Company, Inc., 121 Westboro Road, Grafton, MA, Telephone No. (508) 839-5588 (easterly approximately 3,786 ft. away)
5. Borggaard Construction Corporation, 70 Creeper Hill Road, Grafton, MA, Telephone No. (508) 839-5431 (westerly approximately 3,968 ft. away)

It is assumed that if a release occurred which required evacuation the local home owners/community and local businesses would not be present in their homes or offices. The distances to which a worst case, vapor cloud fire, vapor cloud explosion would occur are discussed in Sections 3.7 and 8.5.

The G&UR will not permit the train engines to enter or exit from the LPGTF if a release condition exists. The local businesses noted above will be contacted via telephone if a release condition exists at the facility that poses a potential fire and/or explosion hazard.

#### **4.0 APPLICABLE GUIDANCE, CODES & STANDARDS**

This section discusses the applicable best management practices (BMPs) and codes which have been incorporated into the design and operation of the G&UR LPGTF.

##### **4.1 NFPA 58 – Liquefied Petroleum Gas Code**

The FSA undertaken is based on the requirements outlined in NFPA 58, 2011 Edition. The LPGTF has been designed in full compliance with NFPA 58.

##### **4.2 NFPA 24 - Standard for Installation of Private Fire Service Mains and Their Appurtenances**

The G&UR utilized the services of MPE, Inc. and Mr. Robert Ceppi a Massachusetts licensed Fire Protection Engineer (FPE) to design the water conveyance system and water cannons to be installed on the G&UR LPGTF. A water line connection will be made in the vicinity of 42 Westboro Road to the 8 inch force main located along the roadway and will be extended onto the site to connect to the water cannons (see Section 5.4 and Appendix D for hydrant test results and water supply availability).

The water service mains will be designed and operated in conformance with NFPA 24. Two hydrostatic flow tests were conducted by Mr. Ceppi on the town hydrants along Westboro Road which indicated that the water supply was sufficient for cooling of the tanks in the events of a fire. Based on flow testing completed of the water hydrants along

Westboro there is approximately 4,000 gallon per minute (gpm) of water available at 20 pounds per square inch (psi). Each water cannon draws approximately 500 gpm leaving approximately 2,000 gpm available for use by the GFD fire trucks. The water used on site to supply the four (4) water cannons and GFD fire trucks is supplied from the water main located along Westboro Road. A new 8 inch water line will be brought onto the Site and a fire hydrant will be located immediately south of the rail car access walkway stairs as shown on Site Plan in Appendix B2 and B3.

## **5.0 MASSACHUSETTS FIRE PROTECTION REGULATIONS**

The Massachusetts fire protection regulations which apply to the design and operation of the LPGTF are discussed below. State and local permitting or preclearance requirements relating to the construction, maintenance and operation of the G&UR LPGTF, including those permit requirements discussed below in Section 5, are categorically preempted by federal law 49. U.S.C. 1051 (b). Notwithstanding the preemption of permitting and preclearance regulations, the G&UR has provided and will continue to provide information and has cooperated and will continue to cooperate with State or local authorities pursuant to regulations intended to protect public health and safety so long as such activities or regulations do not interfere with rail operations, discriminate against rail carriers or unreasonably burden interstate commerce. In the event of any such interference, discrimination or burden, G&UR reserves its right to seek relief on the grounds that the regulations in question are federally preempted.

### **5.1 527 CMR 1.00; Chapter 60.8 - Hazardous Materials Process or Processing**

The G&UR LPGTF is classified as a Category 5 Process which by definition involves or produces hazardous material (HM) in a vessel with a capacity equal to or in excess of threshold quantities stated in 29 CFR 1910.119 or 40 CFR Part 68 and regulated by such standard. A permit is required by 527 CMR 1.00; Chapter 60.8 to process HM and is submitted to and approved by the Head of the Fire Department on a form prescribed by the Fire Marshal. A facility is deemed in compliance with the permit requirements, if a completed application form, signed and attested by the applicant has been filed in accordance with Chapter 60.8.4.

Category 5 Processes must comply with the following requirements as outlined in 60.8.2.4:

1. Implement and self-certify compliance with 29 CFR 1910.119 Process Safety Management of Highly Chapters 60 and 69 Hazardous Chemicals program or with 40 CFR Part 60 Chemical Accident Prevention Provisions;
2. Comply with the permitting requirements of Chapter 60.8.4;
3. Comply with the requirements of Chapter 60.5.1.4.3.2; and
4. Maintain hazard evaluation documents and records for review by the Head of the Fire Department or Marshal for a minimum of two years following issuance of a permit.

An OSHA Process Safety Management (PSM) Plan has been prepared for the LPGTF and has been developed to satisfy both the OSHA PSM standard and the Massachusetts Fire Protection regulations described in 527 CMR 1.00; Chapter 60.8.

## **5.2 502 CMR 5.0 – Permit and Inspection Requirements of Aboveground Storage Tanks of More than Ten Thousand Gallons Capacity**

502 CMR 5.0 includes requirements and procedures for the installation, construction, maintenance and use of Aboveground Storage Tanks (ASTs) and related permit, inspection and record keeping requirements. If any one tank containing LP-gas exceeds 10,000 gallons, then the requirements of 502 CMR 5.0 apply. A Permit and annual inspection of ASTs or containers of more than 10,000 gallon capacity must be undertaken and documentation of compliance with 502 CMR 5.0: Permit Requirements and Annual Inspection of ASTs or containers of more than ten thousand gallons' capacity shall be submitted with the application for a permit to install LP-gas. In accordance with 49 U.S.C. 10501 (b) the G&UR is not required to obtain a permit but will fully comply with the requirements of 502 CMR 5.0.

## **5.3 527 CMR 1.00; Chapter 60 and Chapter 69 – Liquefied Petroleum Gas Containers and Systems**

Chapters 60 and 69 of 527 CMR 1.00 prescribes the minimum standards for LP-gas systems for the protection and safety of the public at large. A permit from the head of the fire department is required to install or connect any LP-gas storage equipment. The application is limited to the storage of LP-gas and the operation of LP-gas systems upstream from the outlet of the first stage regulator. Chapters 60 and 69 adopts and incorporates by reference NFPA 58. In the event of a conflict between the provisions of NFPA 58 and any other provision of Chapters 60 and 69, the standard that requires the greater level of safety will apply.

Railcar shipments of LP-gas intended for distribution within Massachusetts must comply with the odorization thresholds, testing and filling of containers provisions. If ethyl mercaptan is used for odorization purposes, it must be injected at a minimum rate of 1 pound per 10,000 gallons of propane. Each railcar shipment delivered to a bulk plant for distribution is to be tested for odorization using one of the following test methods:

For testing purposes one of the following tests is required to determine adequate ethyl mercaptan odorant levels equivalent to 1 pound per 10,000 gallons of propane.

- (a) Vapor Test using stain tubes resulting in a minimum of 5 parts per million (ppm) of ethyl mercaptan utilizing ASTM D 5305; or
- (b) Flash Vapor Test using stain tubes resulting in a minimum of 17 ppm of ethyl mercaptan utilizing ASTM D 5305; or

- (c) Liquid Test for analysis of volatile sulfurs using gas chromatography resulting in a minimum of 17 ppm of ethyl mercaptan utilizing ASTM D1265.

Effective September 1, 2014, each person handling LP-gas in the quantities of 42 pounds (ten gallons) or greater, shall be trained, in accordance with the Certified Employee Training Program (CETP) or other education programs acceptable to the Marshal. Each person handling cylinders less than 42 pounds shall receive annual training utilizing the program Dispensing Propane Safely published by the Propane Education and Research Council (PERC). Where a gas leak results in imminent danger, immediate verbal notification must be provided to the head of the fire department, and the verbal notification must be followed by written notification within 24-hours of verbal notification documenting the date, time, and the location of discovery and status of such event.

"NO SMOKING" and "STOP ENGINE WHEN REFUELING" signs must be displayed on the front and rear of tanks from which trucks are loaded. The signs shall have block letters at least one inch high with either red letters on a white background or white letters on a red background.

#### **5.4 527 CMR 12.00 (NFPA 70 2014 Edition)**

Electrical devices used in hazardous areas have been certified for use according to the hazardous materials in the surrounding atmosphere as required by 527 CMR 12.00 Electrical Code (NFPA 70, 2014 Edition with Massachusetts Amendments). Propane is classified as a Class I, Division I, Group D flammable gas. Specific wiring methods or a combination of electrical methods including, seals in conduits and cable systems, explosion proof enclosures, enclosures for relays, motors and generators as described in Article 500 apply to Class I locations.

#### **5.5 Completed Fire Safety Analysis Forms**

Appendix A contains the completed FSA Forms which were developed by the National Fire Protection Association (NFPA) and the National Propane Gas Association, 2011 Edition. The FSA was conducted by Dr. Robert S. Palermo a registered Professional Engineer (PE) and Licensed Site Professional (LSP) in Massachusetts. Dr. Palermo is also a Certified Safety Professional (CSP) in comprehensive practice through the Board of Certified Safety Professional (BCSP) and a Registered Professional Industrial Hygienist (PRIH) through the Association of Professional Industrial Hygienists. Dr. Palermo has over thirty years of experience preparing facility plans (e.g., Contingency Plans, Emergency Response Plans, Process Safety Management Plans, etc.) and conducting OSHA HAZWOPER and HAZMAT spill response training. There were no major deficiencies identified as a result of the FSA. Multiple redundant fail safe systems are to be installed at the facility as described in Chapter 6.26 of NFPA 58, 2011 Edition. These systems are being installed to ensure that

safety is incorporated into as many elements of the facility design and operation as can be accomplished.

## **5.6 Site Plan**

The G&UR retained the services of Arthur F. Borden & Associates, Inc. of Raynham, MA on January 13, 2016 to update the existing site plan to reflect existing conditions. Mr. Arthur F. Borden a Massachusetts registered Professional Land Surveyor (PLS) prepared the site plan. The site plan is included in Appendix B1 through B3 and shows the general layout of the site including the existing buildings, structures, railroad lines, truck loading pad, truck offloading rack, and locations of the proposed LPG tanks and associated pipework.

## **5.7 Foundations and Tank Pier Designs**

The G&UR retained the services of Geotechnical Consultants, Inc. (GCI) of Grafton, MA in 2012 to conduct in situ compressive strength test on the concrete and monitor the soil conditions. Mr. Richard Pizzi a registered PE in Massachusetts supervised the work and noted that the compressive strength of the concrete of 3,330 and 3,880 pounds per square inch (psi) exceeds the required design strength. The results of their testing are included in Appendix C1 along with their written reports.

The G&UR retained the services of LPG Ventures who designed and built the G&UR LPGTF. Mr. Albert Hermans a registered PE from SDC Engineering, Inc. provided the flat top pier design for the AST piers which are included in Appendix C2.

As noted above GEI performed the subgrade inspection and monitored the placement and compaction of the structural backfill placed to support the "Flat Top Pier" foundations including the continuous pier footings. The test results and certification of the work were previously performed is contained in Appendix C1.

GEI has reviewed the loads provided by SDC Engineering, Inc. dated 16 February 2016 and the foundation drawings prepared by LPG Ventures dated September 2012. Using the actual footing sizes and loads provided the actual contact pressure between the footings and subgrade is about 1.3 tons per square foot (TSF). Soil gradation and compaction results indicated the subgrade soils are Dense Class 8 Materials and, according to Table 1804.3 of the Massachusetts State Building Code, are capable of supporting up to 3 TSF. Based on the available drawings, provided loads and subgrade test results as noted above, the foundations "as installed" are capable of safely supporting the propane tanks.

## **5.8 Non-Odorized Rail Cars**

The G&UR will be responsible for ensuring that the rail cars being received at the G&UR LPGTF have been adequately odorized prior to shipment from their point(s) of origin (see

Section 5.3). The G&UR will reject receipt and turn away any propane rail car that did not have proper odorization with ethyl mercaptan or equivalent.

Proper odorization with ethyl mercaptan (or equivalent odorant) is essential to safe transport of the propane which has no odor or warning properties unless the odorants are present in sufficient concentration in the LPG rail cars.

The G&UR will use ASTM testing standard D5305 - 12 on each propane car spotted for offloading. This test method covers a rapid and simple procedure using length of stain tubes for field measurement of ethyl mercaptan in the vapor phase of LP-gas systems. Although length-of-stain tubes are available to detect ethyl mercaptan concentrations in the range of 0.5 to 120 parts per million by volume (ppmv), this test method is specifically applicable to systems containing 5 ppmv or more of ethyl mercaptan in LP-gas vapors. The odor threshold for ethyl mercaptan has been reported to be well below 1 ppm.

The odorant level specified in the 2011 Edition of NFPA 58 is 1 pound (lb.) of ethyl mercaptan per 10,000 lbs. of liquid propane gas [LPG] (see A.4.2.1). However it is accepted practice in industry to add 1.5 lbs. to 2.5 lbs. of methyl mercaptan per 10,000 lbs. of LPG.

## **6.0 ADEQUACY OF WATER SUPPLY & USE OF WATER CANNONS**

This section describes the results of the flow testing of the fire hydrants along Westboro Road and the design basis for the water suppression system to cool the tanks in the event of a fire.

### **6.1 Results of Fire Hydrant Testing on October 5, 2012**

Mr. Robert Ceppi, a licensed Fire Protection Engineer (FPE) in Massachusetts of MPE located in Hebron, CT performed the initial hydrant flow testing in Grafton, MA on 42 Westboro Street in the area of the rail yard on October 5, 2012. Mr. Ceppi's report which discusses the findings of his hydrant test is included in Appendix D. The hydrant flow test results note that the town has a good 8-inch water main and a 12-inch water main that provide water flow to the 6 inch main in front of the rail yard from both directions.

It is noted in the report that the last section of 6-inch pipe on 42 Westboro Street in front of the rail yard was to be replaced in 2013. During the flow tests the hydrant water flows were restricted by the Town representative from the Water Department due to an expressed concern that if the hydrant valves were opened too much they may have difficulty closing them back off.

Mr. Ceppi's hydrant testing report indicates that there is a sufficient supply of water along Westboro Road to the hydrants to satisfy the water demand at the G&UR LPGTF in the event of a fire. The water line connection will be approved by the Grafton Water District

prior to performing the work. The G&UR current plan is to install four (4) water cannons and hydrant located on site in the immediate vicinity of the LPG tanks. The 8-inch pipeline extension brought onto the site will provide sufficient volumetric flow in gallon per minute (gpm) to cool 3 of the 4 LPG tanks in the event of a fire. FSA Form 8.3 found in Appendix A identified a requirement of 512 gallons per minute (gpm) for each 80,000-gallon tank with a surface area of 4,098 ft.<sup>2</sup> per LPG tank. The total water demand is 1,536 gallons for three tanks and an additional 250 gpm for fire fighter protection which results in a total combined volumetric flow of 1,875 gpm. Mr. Ceppi's report notes that the available flow is 3,660 gpm which more than exceeds the requirements identified on FSA Form 8.3 of 1,875 gpm.

## **6.2 Results of Fire Hydrant Testing on June 4, 2015**

Mr. Robert Ceppi of MPE, performed a second hydrant test near 42 Westboro Street on June 4, 2015 at a different fire hydrant location. Again the results of the fire hydrant testing indicated that the hydrant water supply is more than adequate to supply sufficient water to cool the tanks in the event of a fire emergency. The results of the June 4 2015 hydrant testing are included in Appendix D and indicate that the available water flow at 20 psi is 4,050 gpm from the hydrant tested on 42 Westboro Road.

## **6.3 Use of Water Cannons for Tank Cooling and Fire Suppression**

Mr. Robert Ceppi of MPE has designed the water cannon fire suppression system to be used at the LPGTF for the purpose of cooling the tanks in the event of a fire emergency. The basis for the water cannon designed is included in Appendix E. The water suppression system provides for four (4) water cannon nozzles which can be used to direct water directly onto the tanks if needed. The water cannons can reach out approximately 135 ft. at 100 psi with a water stream which can be directed at the truck loading area and any of the four tanks or rail cars based on its range in elevation and angle of lateral rotation.

The water cannon plan layout is shown on Figure B2 and shows the locations of the 4 water cannons which will serve the purpose of providing water to the LPG tanks, rail cars and truck loading areas (also see Appendix B2). A new 8-inch fire protection water main will be connected to the existing Grafton, Massachusetts water main in the street and extend onto the LPGTF as shown on Figure B2. Appendix E contains specifications sheets for the monitors and nozzles which will be utilized that have a flow range of approximately 130 to 140 feet with an estimated water flow of 480 gpm. The final selection of the water cannon nozzles is still under evaluation and will be discussed with the GFD to ensure that their concerns have been addressed prior to purchase and installation of the water cannon nozzles.

Each monitor will have an isolation valve that will be locked open and primarily used for maintenance. There will be an automated valve used at the monitor that would be opened

remotely when the monitor is going to be used. The actual manufacturer of the water cannon has not been finalized at this time. The manufacture's recommendations will be followed regarding protection of the nozzle heads from the weather and elements.

During the October 2016 FSA meeting at the GFD the applicability of NFPA 15 – Standard for Water Spray Fixed System for Fire Protection and NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances as it relates to the monitor cannons was further discussed. Mr. Robert Ceppi discussed and confirmed the applicability of the above referenced NFPA standards with a representative (Mr. Eric Nette) from the National Fire Protection Association (NFPA) and concluded that NFPA 15 does not apply to the project since we will not have a fixed spray nozzle system in place around the ASTs and there is no mention of monitor cannons in the subject standard. NFPA 24 does reference water spray fixed systems and monitor nozzles with reference to water supplies. Mr. Ceppi's letter discussing the same has been included in Appendix B2 of the FSA.

## **7.0 OPERATION & MAINTENANCE**

This section described the requirements for basic plant operations and maintenance. The procedures which will be followed during routine facility operations and maintenance of the equipment is discussed below and in greater detail in the National Propane Gas Association (NPGA) and Propane Education & Research Council (PERC) guidelines for propane facilities. Appendix F contains information on the physical properties and characteristics of propane and safety related information and Appendix G1 and G2 on facility operation and operation and maintenance (O&M).

### **7.1 Basic Plant Operations**

The Propane Education & Research Council (PERC) and National Propane Gas Association (NPGA), Certified Employee Training Program for Basic Plant Operations, 2011 Edition will be utilized and followed during routine operations at the G&UR LPGTF. The Basic Plant Operation manual outlines the proper procedures to be followed during plant operations. The OSHA PSM Plan and Health & Safety Manual prepared for the facility operations also contain safety procedures that will be place and followed during operation of the LPGTF.

### **7.2 Operations and Maintenance**

The National Propane Gas Association (NPGA) and Propane Education & Research Council (PERC), Operations & Maintenance Handbook for LPG Storage Facilities, 2009 Edition will be utilized as the operations and maintenance (O&M) for plant maintenance. This handbook has been developed specifically for propane facilities. Additionally, O&M procedures are further discussed in the OSHA PSM Plan for the subject LPGTF (see Appendix G2).

## **8.0 EMERGENCY ACTION PLAN**

An Emergency Action Plan (EAP) has been developed for the LPGTF to address the requirements outlined in Subpart E – Exit Routes, Emergency Action Plans, and Fire Prevention Plans; 29 CFR 1910.33 and Process Safety Management of Highly Hazardous Chemicals, Emergency Planning and Response; 29 CFR 1910.119(n).

The G&U LPGTF has been designed and will be operated to take every reasonable measure and precaution to prevent a propane release from occurring. Early warning detection systems including propane gas sensors utilizing both audible alarms and strobe lights will be used when the facility is in operation. The LPGTF is equipped with a number of protective valve systems including emergency stop valves (ESV), excess flow valves (EFV) which shut down the flow when a leak is detected, and pressure relief valves (PRV) which vent to the atmosphere when tank pressure exceeds a safe limit. The LPGTF is also equipped with a water suppression system that is capable of providing water via the water cannons over the rail cars, ASTs and truck loading pad area to cool the tanks in the event and incident should occur. Regardless of how many protective systems are employed and proactive measures employed it is always a possibility that an incident and release could occur. Therefore, the EAP must be capable of addressing safe evacuation of the LPGTF workers and the local community residing in the immediate area surrounding the facility.

### **8.1 Local Area Evacuation and Further Planning/Integration**

The G&UR had an initial planning meeting on January 21, 2016 at the GFD and included representatives from the GFD and Grafton Police Department (GPD) to discuss a planned approach involving several of the local support agencies to assist in an emergency evacuation. The Town of Grafton has the ability to automatically call local residents/businesses via their emergency call system which will be further investigated to provide emergency notification in the event that an evacuation is required/warranted. The G&UR LPGTF EAP will be expanded to work with and integrate the Town of Grafton emergency response organization and local emergency medical services (EMS) to include the following departments:

- Grafton Fire Department;
- Grafton Police Department;
- Grafton Board of Health Department;
- Grafton Department of Public Works/Engineering;
- UMASS Memorial Hospital/Saint Vincent Hospital; and
- Identification of State Emergency Response Resources/Training Funds.

Several suggestions were offered during the meeting by Police Chief Normand Crepeau which will be further investigated and include:

- Advertise door to door for people to sign up their cell phones to Code Red which is reverse 911. A suggestion was made for the Boy Scouts to get involved with this initiative;
- Obtain downloads of Wireless Information System for Emergency Responders, which shows a plume overlay with wind direction (<http://wiser.nlm.nih.gov/>);
- Create a call list for major facilities in the area, such as CSX, Washington Mills and possibly Tufts;
- Install a siren with several different sounds nearby to alert residents (one sound is practical);
- Discuss the Policy to open the High School as a Shelter in Place if required.

## **8.2 GU&R LPGTF Evacuation Notifications and Protocols**

The G&UR, train personnel, propane truck drivers, contractors and G&UR LPGTF personnel on site will be notified of an evacuation condition by the sounding of an audible warning device/alarm. Train personnel (e.g., GU&R and CSX) crew will be notified by radio and cell phone as a backup. The CSX and MBTA Dispatchers will be notified by the G&UR LPGTF to stop all train movements. Personnel will evacuate to designated mustering areas on the railroad property near the fire suppression shed or at a more distant location to the north across from the railroad tracks along Westboro Road. Accountability will be achieved by maintaining and active sign in list(s) of employees and contractors working at the facility on a daily basis. The list will be updated each morning and personnel will be added to the list each morning as part of the daily safety briefing.

When a high alarm propane sensor condition is observed and the monitor alarms sounds (see Section 8.5) all non essential personnel will evacuate from the facility. The high alarm condition is set at 1/2 of the LEL for Propane or 1.05 % by volume or 10,500 ppm. The monitor audible alarm will sound if the high alarm condition for Propane is achieved. G&UR LPGTF emergency response personnel who have been trained on the Fire Prevention Plan and on the operation of the water cannon system may operate the water cannon if necessary until the GFD arrives at the facility and assumes operational command and control (C2) of the incident response.

In the event that an evacuation is ordered the following measures will be implemented:

1. The facility evacuation alarm (audible alarm) will be activated.
2. The EVS and/or E-Stops will be immediately activated to close off the flow of propane gas from the four 80,000 gallon AST at the source.

3. The vehicle/truck access gate to the facility will be secured to restrict/prevent access while the facility remains in a shut down status.
4. Propane compressors and pumps will be powered down to prevent start up resulting from flow or pressure control monitoring.
5. All on site personnel will proceed to identified evacuation mustering points with the exception of G&UR LPGTF personnel providing temporary operation of the water cannons until the GFD arrives at the facility and assumes C2. The G&UR LPGTF Manager or his designated representative will muster and account for all personnel present in the designated evacuation area(s). This will be accomplished by conducting a roll call and verifying that all G&UR employees, contractors, truck drivers, and other LPGTF personnel who have signed in at the facility on the subject date have been accounted for.
6. All on site personnel will remain in the designated evacuation mustering locations until instructed otherwise by the GFD Chief/Deputy Chief.
7. All on site personnel will remain clear of and will not obstruct entry or egress of emergency EMS and fire fighting equipment and personnel at the facility.

### **8.3 Public Notifications**

We have collectively discussed our concerns associated with an emergency evacuation associated with a propane release from the G&UR LPGTF and how this activity must be properly coordinated with the local community to achieve an effective evacuation of the area. The G&UR had an initial planning meeting on January 21, 2016 at the GFD that included representatives from the GFD and Grafton Police Department (GPD) to discuss a planned approach involving several of the local support agencies to assist in an emergency evacuation. The Town of Grafton has the ability to automatically call local residents/ and businesses via their emergency call system (e.g., reverse 911) to provide emergency notification in the event that an evacuation is required. The Town of Grafton must be responsible for public notification and taking the lead on public notification since the G&UR has no operational control over any of the Town of Grafton local response resources nor does it have any authority to control and/or activate town emergency response resource. Consistent with the National Incident Management Systems (NIMS) and the Incident Command System (ICS) the local Fire Chief will assume operational command and control of a local incident response as the Incident Commander (IC).

The Town of Shrewsbury streets as noted below are within the potential ½ mile evacuation zone from the G&UR LPGTF tank farm locations and as such may also require notification if a worst case release (e.g., loss of one tank volume of 80,000 gallons) were to occur.

Closest Point at Street Location	Approximate Distance from Center of Tank Farm to Nearest Street Location (ft.)	Town Location	Compass Direction from G&UR LPGTF
Orchard Meadow Drive	2,615 ft.	Shrewsbury	NNW
Grafton Street	1,840 ft.	Shrewsbury	NNW
Holt Street	2,620 ft.	Shrewsbury	N

Note: Grafton-Shrewsbury town line is shown of Figure 5 - Town Map.

The G&UR will verify if any Hot Work permits have been issued by the Town of Shrewsbury Fire Department within the ½ mile distance for the facility tank farm location.

#### 8.4 Contacting Area Businesses with GFD Issued Welding Permits

The GFD and GPD will be notified immediately if a propane alarm condition is achieved as describe in Section 8.3 below. There are also businesses in the area that have been issued Welding Permits by the GFD that will be notified by the LPGTF operations personnel if a high alarm condition is activated by the propane gas monitors. The GFD and GPD and area businesses with a GFD Hot Work Permit will be immediately called by the G&UR LPGTF operations personnel. A representative from the G&UR visited the GFD on April 14, 2016 to obtain copies of Hot Work Permits for facilities located in the immediate area of the G&UR LPGTF. Only one facility was located within a ½ mile from the 42 Westboro Road G&UR LPGTF as noted below:

Earthworks  
108 North Main Street  
North Grafton, MA  
Telephone No. (774) 696-6796

The permit notes that Earthworks performs welding and cutting operations and storage of fuel gases. The permit was issued on September 4, 2015 and approved by Assistant Chief Stephen Charest.

#### 8.5 Notifications Based on Propane Sensor Alarms and Sensor Calibrations

Four (4) Drager Polytron 8310 monitors will be located at the LPGTF at the locations indicated on the Site Plan as shown in Appendix B2. The monitors will provide for early detection and warning in the event of a leak. The monitors are equipped with both an audible alarm and strobe light warning. The monitors can be set to alarm at several alarm thresholds. The propane monitors are located at the following locations to provide for early detection around the LPG tanks, compressor and pumps and rail car unloading:

- By the propane compressor and pump;
- By the E-Stop near the northern railway access stairway;
- By the 1st 80,000-gallon tank on the east side centrally positioned; and
- By the E-Stop near the southern railway access stairway.

The GU&R LPGTF will work with the GFD during the initial start operations of the facility to establish alarm thresholds that are mutually agreeable based on incidental releases and line disconnects so that alarming is minimized and occurs when needed and appropriate. During the first year of operations based on actual transfer operations it is anticipated that alarm thresholds as discussed below based on learned operational experience at the facility will be worked out to the satisfaction of the GDF and the G&UR LPGTF. Therefore, based on operational experience and actual observations the sensor thresholds proposed below will be adjusted accordingly based on input provided by the GFD and the G&UR LPGTF personnel.

The proposed alarm thresholds for the propane sensors were based on what we believe are reasonable for the facility based on discussions that we have to date. For example, we discussed not having the propane sensors sounding during routine propane transfer operations at the facility (e.g., rail car disconnection of propane transfer hoses, truck hose disconnection during propane filling, routine maintenance and repair of equipment, etc.).

An initial notification (phone call) to the GFD will be made if a low alarm condition is observed of 1/4 of the Lower Explosive Limit (LEL) for Propane of 0.525 % by volume or 2,500 part per million (ppm). The monitor light strobe (yellow strobe light) will flash or light if the low alarm condition is achieved but the audible alarm will not be set to sound at this threshold. The propane sensor notification will be automated but in all cases a follow up mandatory manual call will take place to the GFD public safety answering point dispatch.

A follow up and/or initial notification (phone call) will again be made if and when a high alarm condition is observed and the monitor alarms sounds. The high alarm condition will be set at 1/2 of the LEL for Propane or 1.05 % by volume or 10,500 ppm. The monitor audible alarm will sound if the high alarm condition for Propane is achieved. A determination will be made at this point by the G&UR LPGTF Manager and GFD if an evacuation is required or if the release is under control and does not warrant an evacuation at this time.

As noted above the G&UR LPGTF personnel will discuss adjustment of the above thresholds with the GFD based on the initial operation of the LPGTF and propane measurements obtained during the initial 6 months of operations. The final agreed upon sensor thresholds will incorporate adequate response time for personnel to evacuate from the facility but at the same time not unnecessarily cause alarm within the local community.

There will be a manual notification (when a sensor alarm is activated) to the GFD to ensure that the call has in fact been received. It is anticipated that a discussion will also take place with the responding GFD responding personnel when the initial call is placed due to sensor activation. This will likely result in an immediate facility visit by the GFD and subsequent assessment of the release condition and circumstances by the GFD. All calls will be placed directly to the Grafton Fire Department public safety answering point dispatch at 1-508-839-4444 and 1-508-839-8518 and not the State Police which will otherwise receive emergency 911 mobile phone calls.

The G&UR and/or the GFD will perform the routine calibration of the sensors. The G&UR/GFD will adhere to the manufacturer's calibration suggested procedures for the sensors, along with the manufacturer's calibration kit (e.g., calibration gas, regulator, connecting tubes, etc.). The calibration of the equipment is a fast process (2-5 minutes). The sensors will be calibrated one at a time so that the other sensors remain fully operational. The GFD will use a portable LEL Detector/Meter during the calibration cycle of the fixed facility propane sensors so that detection of propane is maintained at all times during the calibration period.

## **8.6 RMP Comp Modeled Propane Release Scenarios**

Figure 6 attached depicts the distances from both a worst case and alternate case propane release scenario. The distances were modeled using U.S. Environmental Protection Agency (EPA) RMP Comp software to estimate the distance at which 1 psi over pressure is achieved. At 1 psi over pressure partial demolition of a house may occur resulting in serious injury to the occupants and shattering of glass windows causing skin lacerations from the flying glass.

The worst case scenario involves the complete release of one 80,000-gallon propane tank (filled to 91.39% of its volume) which results in a vapor cloud explosion with significant force at 1 psi over pressure at a distance of 0.5 miles from the tank source. The alternate case scenario involves a 3-inch pipe propane release over 10-minutes which results in a vapor cloud explosion at 1 psi over pressure at a distance of 0.2 miles from the pipe source. The other alternate case scenario also involves a 3-inch pipe release which results in a vapor cloud fire at 1 psi over pressure at a distance of 0.1 miles from the pipe source.

Based on this modeling the worst case scenario would require an evacuation of a half mile from the LPGTF in the event of a full tank release. The two building structures residing within this distance with the higher occupancy rates as shown on Figure 6 include the North Grafton Elementary School and the North Grafton Public Library.

The release modeling which has been accomplished to date is based on the U.S. EPA RMP guidance including Risk Management Program for Guidance for Offsite Consequence

Analysis, March 2009 and Risk Management Program Guidance for Propane Storage Facilities, March 2009 which model three different release scenarios as described below:

Worst Case Scenario - A worst-case release is defined as the loss of the contents of the single largest vessel (or piping) containing the regulated substance. For propane and other flammable substances, the released substance is assumed to explode and generate a pressure wave that can damage people and structures. The rule requires that the distance to a 1 psi overpressure (at 1 psi, windows will break) be modeled or simply use Table 1 to obtain the distance. Table 1 from the noted EPA references provides the worst-case distance to a 1 psi overpressure for propane tanks. As shown on Table 1 the distance is a maximum ½ mile based on U.S. EPA worst case modeling.

**Table 1 – Distance to a 1 PSI Overpressure**

Nominal Water Capacity (Gallons)	Distance to Endpoint (Miles)
51,001-90,000	0.5
90,001-120,000	0.6

RMP\*Comp is a software system used by EPA and NOAA and was developed to model hazardous substances air releases and vapor cloud fires for flammable gases liquefied under pressure. RMP\*Comp was used to calculate the worst-case distances for a worst case release scenario at a distance of 0.5 miles to 1 psi overpressure. A full tank release of 80,000 gallons (filled to 91.39% of it volume or 310,000 pounds) was used as the source quantity for the modeled release. The result of the RMP\*Comp worst case scenario modeling was included as Figure 6 in the updated Fire Safety Analysis (FSA) dated April 17, 2016. The distance in miles can also be calculated from the following equation which is based on the TNT equivalency method:

$$D_{mi} = 0.0081 \times \left( 0.1 \times W_{lb} \times \frac{HC_f}{HC_{TNT}} \right)^{1/3}$$

$$D \text{ Miles} = 0.0081 [ 0.1 * 310,000 * 46,333/4,680 ]^{1/3}$$

$$D = 0.546 \text{ Miles}$$

The 2016 Version of the Emergency Response Guidebook (ERG), Guide 115 notes an evacuation distance for a large spill of ½ of a mile and if a rail car or tank is involved in a fire the isolation distance recommended in all directions is 1 mile. The differences in distances between the two modeled scenarios (e.g., EPA RMP\*Comp and ERG) can be explained by the differences in the input parameters. The EPA RMP\*Comp estimate was based on a worst case propane release of 80,000 gallon tank, facility specific wind speed, stability class, rural (terrain flat and unobstructed) and air temperature, and as such is

facility specific and the ERG modeled release did not incorporate the same facility specific inputs. One can conclude from the above modeling discussion that for an 80,000 gallon tank the worst case release the distance to evacuate in all direction is approximately ½ of a mile but if the release was greater than one tank volume the ERG 1 mile evacuation distance in all direction would be more appropriate and protective.

As has been discussed at the G&UR LPGTF meetings, the focus of the LPGTF facility design and operations are on a proactive approach and in taking adequate preventive measures to prevent a release or explosion from occurring (e.g., Boiling Expanding Liquid Vapor Explosion [BELVE]). With that said, the focus from a firefighting standpoint is on keeping the tanks cool to prevent a BELVE from occurring and controlling the incident at the facility level. The water cannons, propane sensors, emergence shut off system at the tank source, GFD vehicle access, water supply line brought onto the facility and demonstrating the an adequate water supply is available for firefighting response represents the design and operational initiatives that have been taken to accomplish these goals. The training that will be provided is necessary to ensure that the response teams are familiar with the facility and are prepared to deal with the kinds of responses that would likely unfold should an incident occur are all proactive measures that have been taken to ensure that the emergency responders are well prepared to deal with a potential event.

The FSA in Appendix A - Fire Safety Analysis Completed Forms 4.1 through 9.7 also identifies the local fire assets available for a fire response/emergency who will also be invited to participate in the training programs discussed. We believe that the proactive measures discussed above and in the FSA represent significant efforts on our part to comply with best management practices (BMPs) some of which exceed measures taken by other licensed facilities in Massachusetts and throughout New England.

Since it is our understanding that the GFD will assume incident command and control responsibility (e.g., consistent with ICS/NIMS) we believe it is up to the GFD to establish the evacuation distances that they believe are relevant and appropriate for a specific response. The G&UR will of course provide input and work with the GFD as has been done to date to accomplish this end.

## **8.7 Propane Emergency Response and Evacuation Training**

The G&UR will work with the GFD and GPD to conduct joint emergency response training which will include Table Top Exercises and Mock-Up Training Exercises of propane release scenarios to better train and prepare for a propane incident at the facility. The National Propane Gas Association (NPGA) and Propane Education & Research Council (PERC) have developed guidelines for response personnel responding to propane emergencies which can be utilized as a training resource (see Appendix G3, Propane Emergencies, Third Edition, 2007).

Propane incidents often bring a wide range of organizations to the scene of an incident. This is especially true at major fires or product releases at bulk plants, or at incidents involving bulk cargo tank trucks or rail cars. Personnel with different specialties and expertise must get involved to resolve the problem. The key to success is to have a coordinated incident management structure where all of the players integrate their resources to manage the problem in a coordinated, safe and effective manner.

There are a number of emergency response scenarios that are presented in the NPGA/PERC Propane Emergency, Third edition that can form the basis of the initial Table Top and Mock-Up Training Exercises as summarized below:

Scenario 12 - Fire Involving Stationary Tank

Scenario 19 - Emergency Planning for a Propane Bulk Plant

Scenario 20 - Developing Credible Scenarios for Emergency Response Planning

The G&UR will further investigate initial Table Top training response scenarios involving rail cars and both state and federal funding that may be available to train the Town of Grafton emergency response organizations and the G&UR LPGTF personnel.

The G&UR LPGTF will schedule a follow up table top training exercise in September 2016 with the GFD and other Grafton emergency response personnel to attend. The attendees to participate in the initial table top training exercises will be agreed upon with the GFD.

## **8.8 Procedures for Security Breach**

Security breaches as detected by alarm indication received by the contracted alarm moderating station will first be relayed to on duty railroad/propane facility personnel and then automatically forwarded to the Grafton Police Department. Breaches which are detected by railroad/propane facility personnel will be individually assessed. Breaches which have minimal hazard will be dealt with by railroad/propane facility personnel. Breaches which appear to have a greater threat level will be immediately reported to the Grafton Police Department.

The G&UR LPGTF security monitoring system has the ability to remotely shut down the facility by any person on site, remotely on site, remotely off site by employee or monitoring station. The G&UR LPGTF is completely fenced and secured and access into the facility is restricted to deter unauthorized, intentional entry and/or attack on the facility by terrorists and other unauthorized entrants.

## 8.9 Sequence of Operations

Should an incident occur at the LPGTF that requires a response from the GFD the following sequence of operations will take place:

1. The GFD will be immediately contacted via telephone at 1-508-839-4555 or 1-508-839-8518.
2. Upon arrival at the facility the GFD Chief/Deputy Chief will be briefed by the LPGTF Manager, their identified representative and/or operator in charge of existing conditions at the facility and actions that have been taken by facility personnel to address the reported condition. The accountability of all G&UR LPGTF personnel working at facility will be reported to the GFD upon their arrival at the LPGTF facility. The results of propane gas sensor concentrations/%LEL measurements will be provided to GFD personnel responding to the call.
3. If a release of propane gas has occurred from the rail car LPG transfer operation, compressor, pumps, valves, or associated piping the emergency shut off valve (ESV) or emergency stop valve (E-Stop) system will be immediately activated. Activating the ESV/E-Stop will immediately close off the LPG at the tank source(s). This will result in limiting a release to the quantity or volume of LPG present in the subject line or hose.
4. The LPGTF Manager will determine if a facility evacuation is required based on the reported condition at the facility. If evacuation is ordered all non essential personnel will evacuate from the facility to the designated mustering areas located on/off the facility (railroad property by fire suppression shed and/or north of the facility and on the other side of Westboro Road and the rail tracks).
5. If a fire exists at the facility the water cannon system will be activated if it is safe to do so by G&UR personnel who have been trained in the specific use of this equipment and in initial fire fighting operations. Facility personnel who have been trained on the facility specific Fire Prevention Plan (FPP) and on the operation of the water cannon system will operate the equipment until the GFD arrives at the facility. At that time the GFD Chief/Deputy Chief will determine if continued operation of the water cannon system is warranted and if further operation of the equipment by trained LPGTF personnel is required to address the on site conditions. Once local fire fighting personnel have arrived at the facility, operation of the water cannons will be accomplished by experienced firefighters.
6. The GFD will assume full operational command and control of the incident and call for assistance as necessary from area local fire departments.

7. The LPGTF Manager will complete a detailed written report of the incident with actions taken to prevent the same from reoccurring. All facility operational personnel will be briefed on why the incident occurred and corrective/preventive measures taken by the G&UR LPGTF to prevent reoccurrence of the observed incident.

## 9.0 WORK IN PROGRESS

This section summarizes the work in progress to be undertaken to comply with BMPs, applicable codes, and state regulations as described in this FSA. The following additional work and equipment will be completed/installed at the G&UR LPGTF:

1. An eight-inch water line extension will be brought onto the site from Westboro Street to provide adequate water pressure and flow for the water cannons used to cool tanks, rail cars and GFD fire trucks in the event of a fire. Install the water distribution and water suppression system with four (4) adjustable water cannons and fire hydrant as described in Section 6.3 above.
2. An Emergency back up generator will be provided to the LPGTF to supply emergency power in the event of a power failure. The ESVs are valves which are normally open when electrical power (or pneumatic pressure) is supplied and in the event of a power failure the ESVs would completely close off the entire propane system. The emergency lighting, propane gas monitors and the audio and visual alarm system will require emergency backup power to operate in the event of a power failure due to a storm or heavy snowfall event.
3. A Fire Prevention Plan will be prepared and operation personnel will be trained on the plan.
4. Information will be provided to the Town of Grafton and submitted to the Town of Grafton, MA Fire Department as required by the noted Massachusetts Fire Protection regulations as noted in Section 5.1.
5. Bollard protection will be provided along the eastern and southern side of the AST to protect the tanks from maintenance vehicles and fire truck access.
6. The GFD will receive firefighting training on how to respond to propane fires and emergencies offered through the Massachusetts Firefighting Academy located on 1 State Road in Stow, MA. The training will be organized through Mr. [Norm Seymour \(Tel. 508-397-3842 and 978-567-3211\)](#) the training coordinator at the Massachusetts Firefighting Academy for gas training programs. Dr. Palermo discussed the contents of the propane training with Mr. Norn Seymour on October 17, 2016 that the academy offers for propane firefighting responses which involves both in class instruction on propane awareness and a follow up equipment intensive component offered at the firefighting training academy in Stow, MA. The in class component can be scheduled and delivered at the GFD since it is an exportable training module and the hands on training must be provided at the fire training academy in Stow, MA due to the staging and equipment intensive requirements. The hands

on equipment intensive training (see 6b below) has been tentatively scheduled for December 3, 2016 and December 10, 2016 at the Massachusetts Firefighting Academy and follow up registration is required. The specific propane firefighting training recommended by the Massachusetts Firefighting Academy for firefighters is further described below:

- 6a. Propane Awareness Course (4-hours) which can be delivered at the GFD. Mr. Seymour indicated in his conversation with Dr. Palermo that the academy is very flexible with this course and can deliver and schedule it during the evening at the GFD. The academy instructors will come to the GFD and deliver the awareness level training there. There is no charge for the awareness course since the academy has funds in their training budget to deliver this training.
- 6b. Basic Propane Course (8-hours) which must be delivered at the Massachusetts Firefighting Academy (close to the GFD location) since it is equipment intensive and hands on training on propane responses. There are two dates on Saturdays in December which are being held open for the GFD (December 3rd and December 10th). The cost of the course is \$8,000 to \$10,000 for up to 30 firefighters and will be paid for by the G&UR LPGTF. A formal registration for the Basic Propane Course and payment for the course in advance is required.

After, the above training is completed at the firefighting academy (see 6a and 6b above) the G&UR will invite the GFD to participate in the LPGTF training which is operational specific (e.g., how to activate emergency shut off valves, excess flow valve operation, PRV operation, compressors and pump operations, fuel transferring from rail cars, fueling of trucks, etc.). It is understood as discussed during the FSA meetings at the GFD that the focus of the firefighting training must be on propane firefighting response and less about the day to day operational aspects of the LPGTF facility yet operational awareness training on the propane emergency shut down system may also be beneficial to the GFD as well.

7. The G&UR LPGTF operations personnel will be trained in accordance with the NPGA/PERC required training for operators, and complete the Certified Employee Training Program (CETP) or equivalent educational programs acceptable to the Fire Marshal. These training requirements are further described in detail in the G&UR LPGTF OSHA Process Safety Management Plan. The PERC Plant Operations Manual is included in Appendix J of the OSHA PSM Plan and will be utilized as the source reference document for safe operations and work practices at a LPG plant. The following CETP training modules will be completed by plant operations personnel:

#### 2016 NPGA CETP CERTIFICATION AREAS

##### 1.0 Basic Principles and Practices of Propane (BP&PP) - 2016

The CETP 1.0 Basic Principles and Practices of Propane offers an “entry level, foundational” course primarily about propane's physical and combustion properties, and how propane is produced and transported.

BP&PP is a required certification for the completion of all other CETP Certifications.

Course objectives include:

- Identify the advantages of propane;
- Describe Propane customer applications and strategies for quality customer relations;
- Identify sources, physical properties, and effects of pressure and temperature on propane
- Verify characteristics and purposes of odorants;
- Identify and respond appropriately to service interruptions;
- Identify complete and incomplete combustion
- Identify which propane industry standards, codes, and regulations correspond to job-related tasks
- Recognize and use appropriate personal protective equipment, practices, and procedures; and
- Identify features of bulk plants, DOT/ICC cylinders, and other propane equipment, systems, and materials.

Requirements for 1.0 Certification include the following:

- Passing score on 1.0 Basic Principles and Practices of Propane Examination; and
- Completed 1.0 Basic Principles and Practices of Propane Skills Assessment returned to the testing center within 12 months of passing the examination.

### 3.0 Basic Plant Operations

Primarily designed for employees who work in propane bulk plants, this course provides information, practices, and procedures that support general plant operations tasks.

Course objectives include:

- Identify the main components of a bulk plant;
- Operate the propane liquid supply system;
- Inspect and fill DOT containers;
- Inspect and fill vehicle mounted ASME tanks;
- Requalify DOT cylinders by visual inspection;
- Maintain cylinders and ASME tanks;
- Unload a cargo tank motor vehicle; and
- Maintain bulk plant systems and equipment.

Requirements for Certification include the following:

- Prerequisite: 1.0 BP&PP Certification completed within 12 months of passing the examination;
- Passing score on the 3.0 Basic Plant Operations examination; and
- Completed 3.0 Basic Plant Operations Skills Assessment returned to the testing center within 12 months of passing the examination.

### 3.6 Performing Railcar Product Transfers

Primarily designed for employees who unload bulk propane delivered by railcar and/or load railcars with propane.

Course objectives include:

- Identify the hazards associated with handling and transferring propane and the appropriate personal protective equipment (PPE);
- Explain railcar documentation, condition requirements and spotting procedures;
- Identify bulk plant railcar loading/unloading systems and components;
- Verify the presence of odorant;
- Unload a railcar using the plant compressor;
- Load a railcar with propane; and
- Identify railcar security procedures.

Requirements for Certification include the following:

- Prerequisite: 1.0 BP&P Certification completed within 12 months of passing the examination;
- Passing score on the 3.6 Performing Railcar Product Transfers examination; and
- Completed 3.6 Performing Railcar Product Transfers returned to the testing center within 12 months of passing the exam

The NPGA and PERC, Operations & Maintenance Handbook for LPG Storage Facilities, 2009 Edition will be utilized as the operations and maintenance (O&M) for plant maintenance. This handbook has been developed specifically for propane facilities and represents what we believe are best management practices (BMP) for propane facilities. We believe that this should satisfy the requirement of for a Certified Employee Training Program as required by the MA Fire Prevention Regulations.

All operations personnel working at the G&UR LPG Transfer facility will undergo and complete PERC Training for operators as well as required OSHA training on written safety procedures and programs (see G&UR LPG Transfer Facility Health & Safety Manual) before performing any work operations at the facility.

7. The G&UR acknowledges that it is equally beneficial and necessary for the G&UR LPGTF operational personnel and the GFD to understand and have input into the development of the facility safety programs (e.g., Fire Prevention Plan, Hot Work Permits, Emergency Action Plans, etc.). Prior to the introduction of propane at the facility the G&UR will finalize the required OSHA safety and health programs as described in Section 1.2. As was discussed and agreed upon at the FSA meetings the GFD will be provided with the referenced documents and opportunity to review and comment on the subject documents. The GFD will also be invited to attend the LPGTF facility personnel training on the subject programs should they elect to do so.

## **10.0 LIMITATIONS**

The FSA was based on requirements outlined in the Fire Safety Analysis Manual for LP-Gas Storage Facilities which addresses the requirements outlined in the 2011 Edition of NFPA 58 Liquefied Petroleum Gas Code developed by the National Fire Protection Association (NFPA) and the National Propane Gas Association (NPGA). The FSA completed is a self-conducted audit of the safety features of the G&UR LPGTF propane facility and an assessment of the means to minimize the potential for inadvertent propane releases from containers and during transfer operations. The assessment also includes an evaluation of the capabilities of local emergency response agencies as well as an analysis of potentially hazardous exposures from the installation to the neighborhood and from the surroundings to the LP-Gas facility. The FSA and FSA at the time of preparation was representative of current Site conditions.

This FSA was specifically prepared for the G&UR and may not be used or reproduced without the permission of the G&UR and without the consent of EBI. This report contains information regarding fire safety analysis and compliance with BMPs and fire protection regulations. It is not intended to address other requirements or conditions that may apply to the G&UR LPGTF under federal regulations (e.g., OSHA General Industry Standards and EPA Chemical Accident Prevention Provisions). These requirements are addressed under separate plans and are identified in the reference section which follows.

## **11.0 REFERENCES**

The following references apply to this FSA:

1. National Fire Protection Code (NFPA) and National Propane Gas Association (NPGA) Fire Safety Analysis Manual for LP-Gas Storage Facilities.
2. The Propane Education & Research Council (PERC), Basic Plant Operations, Modules 1-9, PERC 2011.
3. National Fire Protection Code (NFPA) and National Propane Gas Association (NPGA) Operations & Maintenance Handbook for LPG Storage Facilities, 2009 Edition.

4. The National Propane Gas Association (NPGA) and Propane Education & Research Council (PERC), Propane Emergencies, Third Edition, 2007.
5. Occupational Safety and Health Administration (OSHA), Process Safety Management of Highly Hazardous Chemicals; 29 CFR 1910.119.
6. Massachusetts Fire Protection Regulations, 527 CMR 1.00; Chapter 60.8; Hazardous Materials Process or Processing.
7. Massachusetts Fire Protection Regulations, 527 CMR 1.00; Chapter 60 and Chapter 69 - Liquefied Petroleum Gas Containers and Systems.
8. Massachusetts Fire Protection Regulations, 502 CMR 5.00 - Permit and Inspection Requirements of Aboveground Storage Tanks of More Than 10,000 Gallons Capacity.
9. Massachusetts Fire Protection Regulations, 527 CMR 12.00 Electrical Code (NFPA 70, 2014 Edition with Massachusetts Amendments)
10. National Fire Protection Code (NFPA) 58 – Liquefied Petroleum Gas Code.
11. Occupational Safety and Health Administration (OSHA), Emergency Action Plan (EAP); 29 CFR 1910.38.
12. Occupational Safety and Health Administration (OSHA), Fire Prevention Plan (FPP); 29 CFR 1910.39.
13. Occupational Safety and Health Administration (OSHA), Hazardous Waste Operations and Emergency Response (HAZWOPER); 29 CFR 1910.120.
14. Occupational Safety and Health Administration (OSHA), The Control of Hazardous Energy (LOTO); 29 CFR 1910.147.
15. Occupational Safety and Health Administration (OSHA), Hot Work Programs; 29 CFR 1910.252.
16. U.S. Environmental Protection Agency (EPA), Risk Management Plan (RMP); 40 CFR Part 68; Section 112(r).