

**Model Hazardous Materials Emergency Response Procedures**

Florida State Working Group HazMat Operations

*Rev. March 22, 2019.*

*Flaring of Liquefied Petroleum Gases (LPG)*

---

**Title: Container Emergencies - Flaring of Liquefied Petroleum Gases (LPG)**

**Purpose**

To establish procedures and provide guidance to the Hazardous Materials Response Team when they encounter a situation that would require the flaring of LPG at a hazardous materials emergency incident.

**Definitions**

**Flaring** – Controlled burning of a high vapor pressure liquid or compressed gas in order to reduce or control the pressure and / or dispose of the product.

**Auto-refrigeration** – As propane vaporizes, the liquid portion in the tank cools. If the vapor rate is high enough the liquid will refrigerate to as low as -44° F (propane's boiling point), at this point vaporization will stop and it will appear the container is empty while super-cooled liquid remains in the container.

**Policy**

This procedure will apply to all incidents where the Hazardous Materials Response Team responds and determines that a flaring operation would be appropriate.

- Used to achieve three basic objectives:
  1. Reduce the pressure inside of a cargo or storage tank
  2. Dispose of vapors remaining inside of the tank after liquid has been transferred.
  3. Flare liquid when other transfer methods are not possible
- Flaring is an acceptable alternative when it is necessary to expedite recovery operations
- Flaring is also an alternative, as an interim step, when other product transfer operations are not available, or not possible due to accessibility.

**Applicability**

This policy shall be utilized to guide selection and use of the appropriate equipment in performing a flaring operation. The Hazardous Materials Group Supervisor is responsible for ensuring that the Incident Commander is aware of the hazards involved. The Hazardous Materials Response Team is responsible for follow these guidelines to ensure the safety of the Hazardous Materials Response Team members, operations personnel, and the general public.

**Procedure:**

1. Identify Hot Zone, if not already done, and secure area:

**Model Hazardous Materials Emergency Response Procedures**

Florida State Working Group HazMat Operations

*Rev. March 22, 2019.*

*Flaring of Liquefied Petroleum Gases (LPG)*

---

**FLARING OF LIQUEFIED PETROLEUM GASES – continues:**

- a) The Hot Zone will include the area of radiant heat exposure, not just the area affected by the product release.
    - i. All items and structures exposed to radiant heat must be protected with a hose stream and shielding, as appropriate.
    - ii. Hose streams must be of sufficient size to adequately dissipate the radiant heat.
      - Caution - Large volumes of water could cause flooding and potential movement of containers.
  - b) Only personnel essential to the operation should be in Hot Zone.
2. Verify contents of container using:
- a) Use D.O.T. labeling, Compressed Gas Association labels, lettering, etc.
  - b) Color of cylinder (use caution as color coding is not standardized except for the medical gas industry standard.)
  - c) Type of valve, relief devices or absence of, and connections.
  - d) Shape, design, and size of tank.
  - e) Information from responsible party.
3. Determine what the problem is and the options to mitigate it:
- a) Fire
    - i. “Tank Side” or “Service Side”
  - b) Product Leaking (vapor, liquid, or both):
    - i. Valve damage or failure
    - ii. Gauge damage or failure
    - iii. Leaking from “Tank Side” or “Service Side”
    - iv. Overfilled
    - v. Pressure Reduction Device (PRD) activation
  - c) Container damage or failure
4. Determine whether it is safe to conduct flaring operation:
- a) Proper equipment available to perform flaring operation.
  - b) Adequate exposure protection available.
  - c) Adequate water supplies available to perform exposure cooling for the duration of flaring operation.

**Model Hazardous Materials Emergency Response Procedures**

Florida State Working Group HazMat Operations

*Rev. March 22, 2019.*

*Flaring of Liquefied Petroleum Gases (LPG)*

---

**FLARING OF LIQUEFIED PETROLEUM GASES – continues:**

- d) Identify all exposures.
  - e) Sufficient distances available from flare to exposures.
  - f) Consensus with product supplier to flare.
  - g) Area free of flammable vapors, or vapors appropriately suppressed before beginning the flaring operation.
  - h) Damage assessment done of tank.
  - i) Overhead power lines removed or de-energized.
  - j) Position of tank does not prevent safe removal of product.
5. Specific site safety considerations which should be addressed during this phase of the incident include:
- a) Ensure that backup crew is available and in place to protect all personnel involved in the flaring operation.
  - b) A minimum of two 1 ¾" hose-lines shall be deployed; one to protect firefighters and one for possible exposures.
  - c) Make sure all personnel know the emergency evacuation signal and the escape path for personnel working in the Hot Zone prior to beginning the flaring operation.
  - d) Continuously monitor the hazard area with a Combustible Gas Indicator (CGI) or LEL sensor on a multi-gas monitor.
  - e) Maintain hazard control zones throughout the flaring operation and enforce usage of full PPE usage by personnel working in the hot zone.
  - f) Ensure all personnel remain alert throughout the operation. Frequent relief and rotation of personnel should be considered to prevent issues.
  - g) Ensure the burner head is at a sufficient height above the ground to prevent ground fires and damage to flaring equipment. (Remember flaring of liquid product produces much greater radiant heat than vapor).
6. The following operational steps shall be utilized to set-up, operate, and shut-down a flare kit:
- a) In the vertical position, open the leg system and ensure they are fully extended and secured.
  - b) Anchor all legs into stable soil, or secure using sandbags if flare is set up on a hard surface (use caution to ensure the sandbags do not melt or catch fire during the flaring operation).

**Model Hazardous Materials Emergency Response Procedures**

Florida State Working Group HazMat Operations

*Rev. March 22, 2019.*

*Flaring of Liquefied Petroleum Gases (LPG)*

---

**FLARING OF LIQUEFIED PETROLEUM GASES – continues:**

- c) Connect pilot lines to 20lb propane bottle.
- d) Attach appropriate product recovery valve to the damaged/leaking vessel, leave closed.
- e) Connect flare lines to product recovery valve on the damaged/leaking vessel.
- f) Assess area for flammable vapors using a CGI and/or LEL monitor.
- g) Slowly open valve on the pilot tank and test ALL connections with a leak check solution.
- h) If no leaks are detected, extend mast to its full height.
- i) Light the pilot side of the flare using an appropriate device.
- j) Remove all personnel from the flare area and wet down the ground under the flare.
- k) Slowly open the recovery valve on the damaged/leaking vessel and test ALL connections with a leak check solution.
- l) Slowly open flare valve and regulate as needed to control flame height
  - a. Ensure a firefighter in full PPE maintains control of the flare operation valve(s) at all times in case an emergency shut-down is needed.
- m) Warm the damaged/leaking tank as needed with a hose line to prevent auto-refrigeration, unless the goal of the flaring operation IS auto-refrigeration.
- n) Keep the ground under the flare wet/cool for the duration of the flaring operation.
- o) When shutting down the flaring operation, remember to begin the shut down from the damaged/leaking vessel to prevent trapping liquid fuel in the flare lines.
  - a. If liquid is trapped between the vessel and the control valves, injury to responders could occur when the lines are disconnected.
- p) Terminate all operations if ANY of the following occurs:
  - a. Presence of flammable vapors
  - b. Exposure fire occurs
  - c. Gas leaks are noted in the flare lines or fittings
  - d. Pilot light is extinguished

**Model Hazardous Materials Emergency Response Procedures**

Florida State Working Group HazMat Operations

*Rev. March 22, 2019.*

*Flaring of Liquefied Petroleum Gases (LPG)*

---

**FLARING OF LIQUEFIED PETROLEUM GASES – continues:**

- e. Flare mast is disrupted or falls
- f. Any other unsafe issue is found

**Minimum Equipment Required:**

1. 100 feet of 1-inch flaring hose.
2. Flaring tree stand with burner for both liquid and gas.
3. Either a liquid recover valve or vapor recovery valve to connect to damaged/leaking vessel and hose.
4. Road flare (or other appropriate device) on six foot or longer pole to light pilot side of flare.
5. 20lb propane bottle for pilot light.
6. CGI or LEL sensor-equipped monitor.

**Reference Charts:**

**Flaring rates for 1-inch diameter hose**

<b>Flow Rates for 1-inch Diameter Hose</b>				
<b>Propane Temp, F°</b>	<b>Flow Rate, Gallons/Hour</b>	<b>Flow Rate, Lbs/Hour</b>	<b>Flow Rate, BTU/Hour</b>	<b>Time to Empty 30,000 of LPG, in Hours</b>
0	169	710	15,435,277	177.5
10	215	903	19,636,595	139.5
20	258	1,084	23,563,914	116.3
30	312	1,310	28,495,896	96.2
40	364	1,529	33,245,212	82.4
50	420	1,764	38,359,860	71.4
60	501	2,104	45,757,833	59.9
70	541	2,272	49,411,153	55.5
80	701	2,944	64,024,433	42.8
90	775	3,255	70,783,075	38.7
100	825	3,465	75,349,725	36.4
110	957	4,019	87,405,381	31.3

**Model Hazardous Materials Emergency Response Procedures**

Florida State Working Group HazMat Operations

*Rev. March 22, 2019.*

*Flaring of Liquefied Petroleum Gases (LPG)*

---

**FLARING OF LIQUEFIED PETROLEUM GASES – continues:**

**Ambient temperature to expected vessel pressure**

<b>Ambient Temp, F°</b>	<b>Approx. Expected Pressure, PSIG</b>
<b>0</b>	<b>23</b>
<b>10</b>	<b>31</b>
<b>20</b>	<b>40</b>
<b>30</b>	<b>51</b>
<b>40</b>	<b>63</b>
<b>50</b>	<b>77</b>
<b>60</b>	<b>95</b>
<b>70</b>	<b>109</b>
<b>80</b>	<b>128</b>
<b>90</b>	<b>149</b>
<b>100</b>	<b>172</b>
<b>110</b>	<b>197</b>
<b>120</b>	<b>225</b>
<b>130</b>	<b>257</b>