Office of the Secretary, HUD

Isobutyl Acetate  Methyl Cellosolve
Isobutyl Alcohol  Methyl Ethyl Ketone
Isopropyl Acetate  Naphtha
Isopropyl Alcohol  Pentane
Jet Fuel and  Propylene Oxide
Kerosene  Toluene
Methyl Alcohol  Vinyl Acetate
Methyl Amyl Alcohol  Xylene

HAZARDOUS GASES
Acetaldehyde  Liquefied Natural
Butadiene  Gas (LNG)
Butane  Liquefied Petroleum
Ethene  Gas (LPG)
Ethylene  Propane
Ethylene Oxide  Propylene
Hydrogen  Vinyl Chloride


[49 FR 5105, Feb. 10, 1984; 49 FR 12214, Mar. 29, 1984]

APPENDIX II TO SUBPART C OF PART 51—DEVELOPMENT OF STANDARDS; CALCULATION METHODS

I. Background Information Concerning the Standards

(a) Thermal Radiation:

(1) Introduction. Flammable products stored in above ground containers represent a definite, potential threat to human life and structures in the event of fire. The resulting fireball emits thermal radiation which is absorbed by the surroundings. Combustible structures, such as wooden houses, may be ignited by the thermal radiation being emitted. The radiation can cause severe burns, injuries and even death to exposed persons some distance away from the site of the fire.

(2) Criteria for Acceptable Separation Distance (ASD). Wooden buildings, window drapes and trees generally ignite spontaneously when exposed for a relatively long period of time to thermal radiation levels of approximately 10,000 Btu/hr. sq. ft. It will take 15 to 20 minutes for a building to ignite at that degree of thermal intensity. Since the reasonable response time for fire fighting units in urbanized areas is approximately five to ten minutes, a standard of 10,000 BTU/hr. sq. ft. is considered an acceptable level of thermal radiation for buildings.

People in outdoor areas exposed to a thermal radiation flux level of approximately 1,500 Btu/ft² hr will suffer intolerable pain after 15 seconds. Longer exposure causes blistering, permanent skin damage, and even death. Since it is assumed that children and the elderly could not take refuge behind walls or run away from the thermal effect of the fire within the 15 seconds before skin blistering occurs, unprotected (outdoor)
ignited. In most cases, hazardous substances will be stored in pressurized containers. The resulting blast overpressure will be experienced at a greater distance than the resulting thermal radiation for the standards set in Section 51.203. In any event the hazard requiring the greatest separation distance will prevail in determining the location of HUD-assisted projects.

The standards developed for the protection of people and property are given in the following table.

<table>
<thead>
<tr>
<th>Amount of acceptable exposure allowed for building structures.</th>
<th>Thermal radiation</th>
<th>Blast overpressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>10,000 BTU/ft²/hr.</td>
<td>0.5 psi.</td>
<td></td>
</tr>
<tr>
<td>450 BTU/hr</td>
<td>0.5 psi.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Amount of acceptable exposure allowed for people in open areas.</th>
<th>Thermal radiation</th>
<th>Blast overpressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>450 BTU/hr</td>
<td>0.5 psi.</td>
<td></td>
</tr>
</tbody>
</table>

**Problem Example**

The following example is given as a guide to assist in understanding how the procedures are used to determine an acceptable separation distance. The technical data are found in the HUD Guidebook. Liquid propane is used in the example since it is both an explosion and a fire hazard.

In this hypothetical case a proposed housing project is to be located 850 feet from a 30,000 gallon liquid propane (LPG) tank. The objective is to determine the acceptable separation distance from the LPG tank. Since propane is both explosive and fire prone it will be necessary to determine the ASD for both explosion and for fire. The greatest of the two will govern. There is no dike around the tank in this example.

A nomographs from the technical Guidebook have been reproduced to facilitate the solving of the problem.

**ASD For Explosion**

Use Figure 1 to determine the acceptable separation distance for explosion.

The graph depicted on Figure 1 is predicated on a blast overpressure of 0.5 psi. The ASD in feet can be determined by applying the quantity of the hazard (in gallons) to the graph.

In this case locate the 30,000 gallon point on the horizontal axis and draw a vertical line from that point to the intersection with the straight line curve. Then draw a horizontal line from the point where the lines cross to the left vertical axis where the ACCEPTABLE SEPARATION DISTANCE of 660 feet is found.

Therefore the ASD for explosion is 660 feet.

Since the proposed project site is located 850 feet from the tank it is located at a safe distance with regards to blast overpressure.
To determine the ASD for fire it will be necessary to first find the fire width (diameter of the fireball) on Figure 2. Then apply this to Figure 3 to determine the ASD.

Since there are two safety standards for fire: (a) 10,000 BTU/ft²/hr. for buildings; and (b) 450 BTU/ft²/hr. for people in exposed areas, it will be necessary to determine an ASD for each.

To determine the fire width locate the 30,000 gallon point on the horizontal axis on Figure 2 and draw a vertical line to the straight line curve. Then draw a horizontal line from the point where the lines cross to the left vertical axis where the FIRE WIDTH is found to be 350 feet.
Now locate the 350 ft. point on the horizontal axis of Figure 3 and draw a vertical line from that point to curves 1 and 2. Then draw horizontal lines from the points where the lines cross to the left vertical axis where the ACCEPTABLE SEPARATION DISTANCES of 240 feet for buildings and 1,150 feet for exposure to people is found. Based on this the proposed project site is located at a safe distance from a potential fireball. However, exposed playgrounds or other exposed areas of congregation must be at least 1,150 feet from the tank, or be appropriately shielded from a potential fireball. (Source: HUD Handbook, "Urban Development Siting With Respect to Hazardous Commercial/Industrial Facilities.")
[49 FR 5105, Feb. 10, 1984; 49 FR 12214, Mar. 29, 1984]