



Safety Aspects in Transportation & Storage of LPG

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Emergency Preparedness & Disaster Risk Reduction in Chemical
Industry**

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Definitions

Hazard

Situation with a potential for damage to people, machines and environment.

Ex : fire / explosion in LPG storage

: toxicity in chlorine storage

Risk

Combination of hazard consequence and its frequency of occurrence.

Ex: likely death of two persons in 100 years due to loading hose failure.

Definitions

Flash Point

The flash point of a liquid is the lowest temperature at which sufficient vapour given off to flash on the application of flame in the presence of air.

Auto – Ignition

The lowest temperature to which a solid , liquid or gas requires to be raised to cause self-sustained combustion without initiation by a spark or flame.

Definitions

Explosive limits

Explosive limits are those concentrations of a vapor or gas in air below or above which propagation of a flame does not occur on contact with a source of ignition.

LEL: Lower explosive Limit

The lower explosive limit is the minimum concentration below which the vapor air mixture is too lean to burn or explode.

UEL: Upper Explosive Limit

The upper explosive limit is the maximum concentration above which the vapor air mixture is too rich to burn or explode.

Definitions

U N Number

The United Nations number is a four figure code used to identify hazardous chemicals and is used for identification of chemicals transported internationally by road, rail and by air.

CAS Number

The Chemical Abstracts Service Registry is a numeric designation assigned by American Chemical Society's Chemical Abstract Service and uniquely identifies a specific chemical compound. This entry allows one to conclusively identify a material regardless of the name or naming system used.

Definitions

HAZCHEM Code

- **HAZCHEM is a warning plate system used for vehicles transporting hazardous substances, and on storage facilities housing such substances.**
- **It gives the fire fighting and spillage control procedures to be adopted for each chemical.**
- **The HAZCHEM Code consists of either two or three characters, the first being a numeral, followed by either one or two letters.**

Definitions

HAZCHEM Code

- **The numeral** in the range 1 to 4 indicates the type of medium to be employed by the fire services personnel.
 - ✓ 1 - indicates the use of solid streams of water
 - ✓ 2 - indicates the use of a water fog or fine water spray
 - ✓ 3 - indicates the use of a water-based foam
 - ✓ 4 - indicates the use of a dry agent such as a dry chemical powder, eg. sodium carbonate or dry sand
- **The First Letter** (or second character) indicates the type of personal protection to be worn, the possibility of violent reaction, and whether the substances and the medium employed should be contained or the substances diluted. The characters are generally black on a white background.
- **The third character**, when appearing, is the letter E. This indicates that evacuation of persons in the neighbouring areas must be taken into consideration.

Item	Letter	Indicates
Personal protection	P, R, W, X	Full chemical protection suit and breathing apparatus should be worn.
	S T Y Z	Breathing apparatus need only be worn if the substances are involved in a fire.
Contain or Dilute	P, R, S, T	Dilution
	W, X, Y, Z	Containment
Violent Reaction	P, S, S , W, Y, Y	A violent reaction may occur through such occurrences as decomposition, ignition of vapours, acceleration of combustion due to involvement of an oxidising agent or reaction with water.

HAZCHEM Code

Hazchem Scale FOR FIRE OR SPILLAGE

U/N No.	◊
Hazchem	

- 1 **JETS**
- 2 **FOG**
- 3 **FOAM**
- 4 **DRY AGENT**

P	V	FULL	DILUTE
R			
S	V	BA	
S		BA for FIRE only	
T		BA	
T		BA for FIRE only	
W	V	FULL	CONTAIN
X			
Y	V	BA	
Y		BA for FIRE only	
Z		BA	
Z		BA for FIRE only	
E		CONSIDER EVACUATION	

Notes for Guidance

FOG

In the absence of fog equipment a fine spray may be used.

DRY AGENT

Water must not be allowed to come into contact with the substance at risk.

V

Can be violently or even explosively reactive.

FULL

Full body protective clothing with BA.

BA

Breathing apparatus plus protective gloves.

BA for FIRE only

For fires BA essential. If no fire BA not essential for short exposure.

DILUTE

May be washed to drain with large quantities of water.

CONTAIN

Prevent, by any means available, spillage from entering drains or water courses.

CONSIDER EVACUATION

This is the first priority. In case of doubt evacuate immediate vicinity and request police assistance.

HAZCHEM Code and UN Number

Product	UN Number	HAZCHEM Code
LPG	1075	2 W E
NAPHTHA	1255	3 Y E
MS	1203	3 Y E
SK	1223	3 Y
HSD	1202	3 Y E
FO	1270	3 Y E
CRUDE OIL	1267	2 W E

Liquefied Petroleum Gas (LPG)

- ❖ **LP Gas is a general term for a family of liquefied gases, which includes propane and butane and propylene gases in their liquid forms.**
- ❖ **Automotive LP Gas (autogas) is a mixture of propane and butane. It is not the same as the LP Gas used in domestic and portable LP Gas appliances (which is pure propane), and should not be used with these appliances.**

Liquefied Petroleum Gas

- ➔ Gas is transported under pressure as a liquid in tankers and cylinders.
- ➔ Vaporizes rapidly on release and spreads steadily along the ground.
- ➔ Is colorless, hence cannot be seen.
- ➔ Mercaptan is added to odorize LPG.
- ➔ Density of liquid LPG is $0.51 - 0.58 \text{ gm/cm}^3$ at $15 \text{ }^\circ\text{C}$ and is about half the weight of water.
- ➔ Is heavier than air and will collect in low lying areas.
- ➔ Forms explosive mixture with air.
- ➔ Auto Ignition Temperature is around $410 - 580 \text{ }^\circ\text{C}$
- ➔ Causes dizziness and drowsiness. Vapourising liquid causes frostbite / cold burn.

LPG Safety

Any accident while handling LPG during processing, storage or transport is always accompanied by one or combination of the following:

- ❖ Fire
- ❖ Explosion
- ❖ Spillage of LPG from storage or during handling/ transportation.

LPG Storage

Being essentially a liquefied gas, LPG cannot be stored at atmospheric pressure and temperature.

Two methods of storage can be used:

1. In a pressure vessel at atmospheric temperature but high pressure.

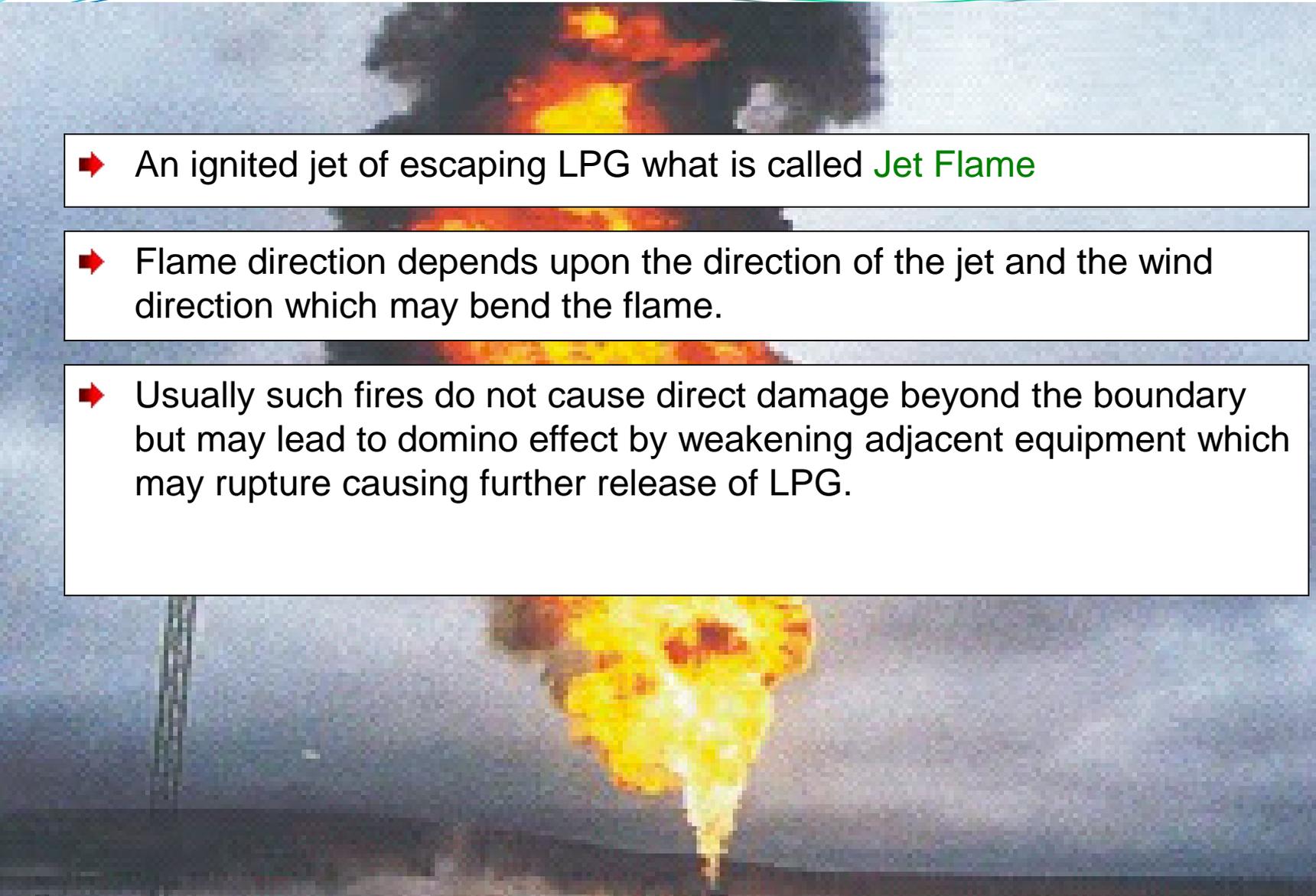


LPG Storage

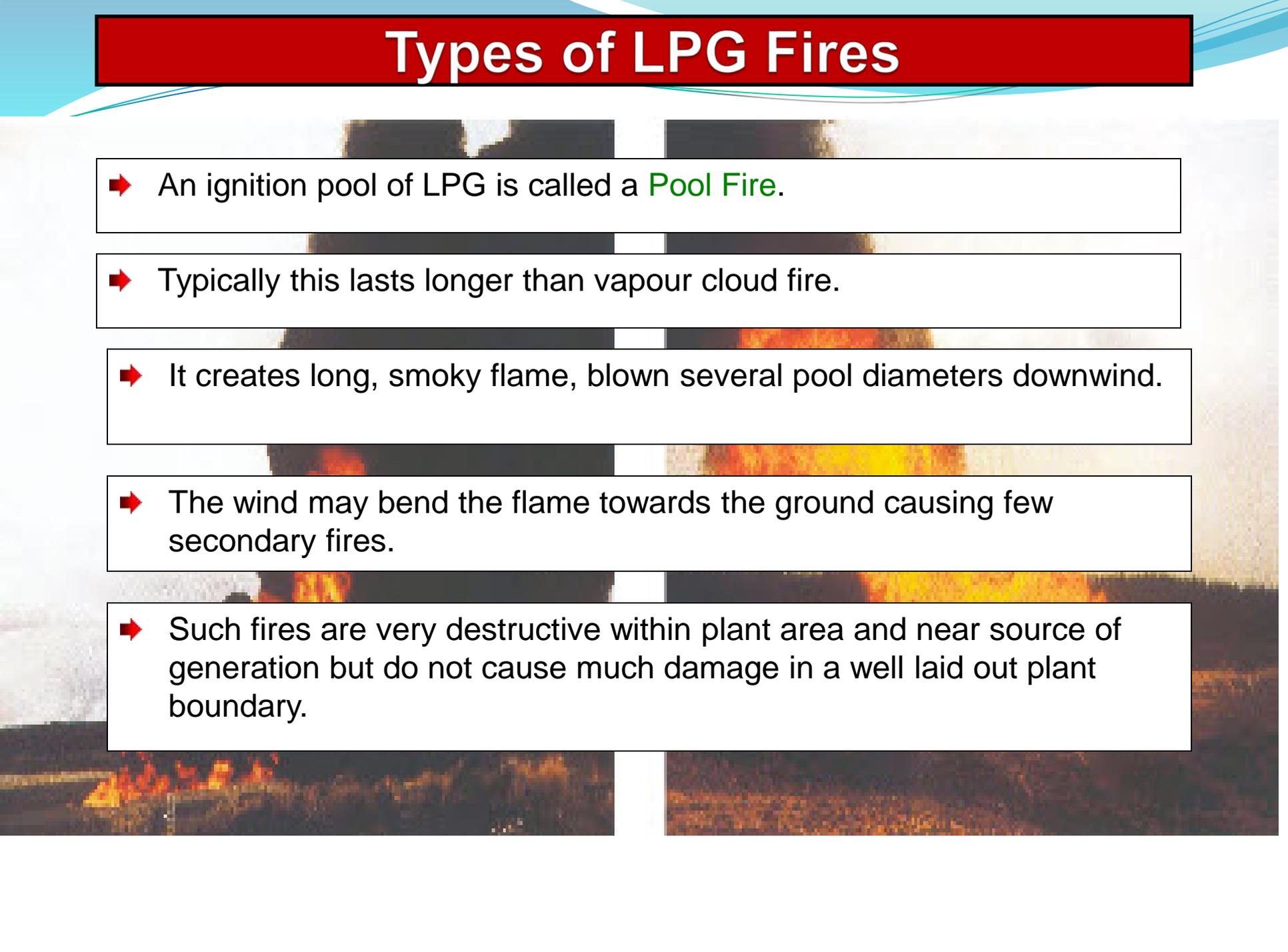
2. In an insulated vessel at low temperature but only slightly above atmospheric pressure often referred to as refrigerated storage. LPG must be chilled to approximately minus 29 deg. C to minus 33 deg. C depending upon the composition to liquefy at atmospheric pressure.



Types of LPG Fires

- 
- An ignited jet of escaping LPG what is called **Jet Flame**
 - Flame direction depends upon the direction of the jet and the wind direction which may bend the flame.
 - Usually such fires do not cause direct damage beyond the boundary but may lead to domino effect by weakening adjacent equipment which may rupture causing further release of LPG.

Types of LPG Fires

- 
- An ignition pool of LPG is called a **Pool Fire**.
 - Typically this lasts longer than vapour cloud fire.
 - It creates long, smoky flame, blown several pool diameters downwind.
 - The wind may bend the flame towards the ground causing few secondary fires.
 - Such fires are very destructive within plant area and near source of generation but do not cause much damage in a well laid out plant boundary.

Types of LPG Fires

- ➔ Clouds of LPG vapour mixed with air may sustain a propagation flame when ignited.
- ➔ In certain cases the flame may take place in seconds.
- ➔ Radiation intensity is severe, similar to a fire ball. This is known as **Flash Fire**.
- ➔ Any person caught in flash fire would sustain fatal burn injuries.
- ➔ The flash fire from a continuous release source would result into fire at source (pool fire or jet fire)

Types of LPG Fires

PASADENA, 23.10.1989, USA

- ➔ If the flame travels fast, overpressure or blast effects will be created which can cause severe damage at considerable distance from the source of leak.
- ➔ Vapour cloud ignites and explodes causing high overpressure and consequent damage.
- ➔ The phenomenon can also be termed as **Vapour Cloud Explosion** (that can be confined or unconfined).
- ➔ Escalation due to vapour cloud explosion is very likely as it would result in failure of adjoining facilities.
- ➔ Tanks and buildings in particular are susceptible to damage from Vapour cloud explosion

Types of LPG Fires

- ➔ Clouds of vapour may burn as a **Fire Ball**.
- ➔ This is nearly a spherical cloud of flammable material burning with much turbulence and rising as it mixes with the surrounding air.
- ➔ The thermal dose and radiation from such a fire ball is very intense and can cause a great deal of damage.
- ➔ Also known as **BLEVE- Boiling Liquid Expanding Vapour Explosion**

BLEVE

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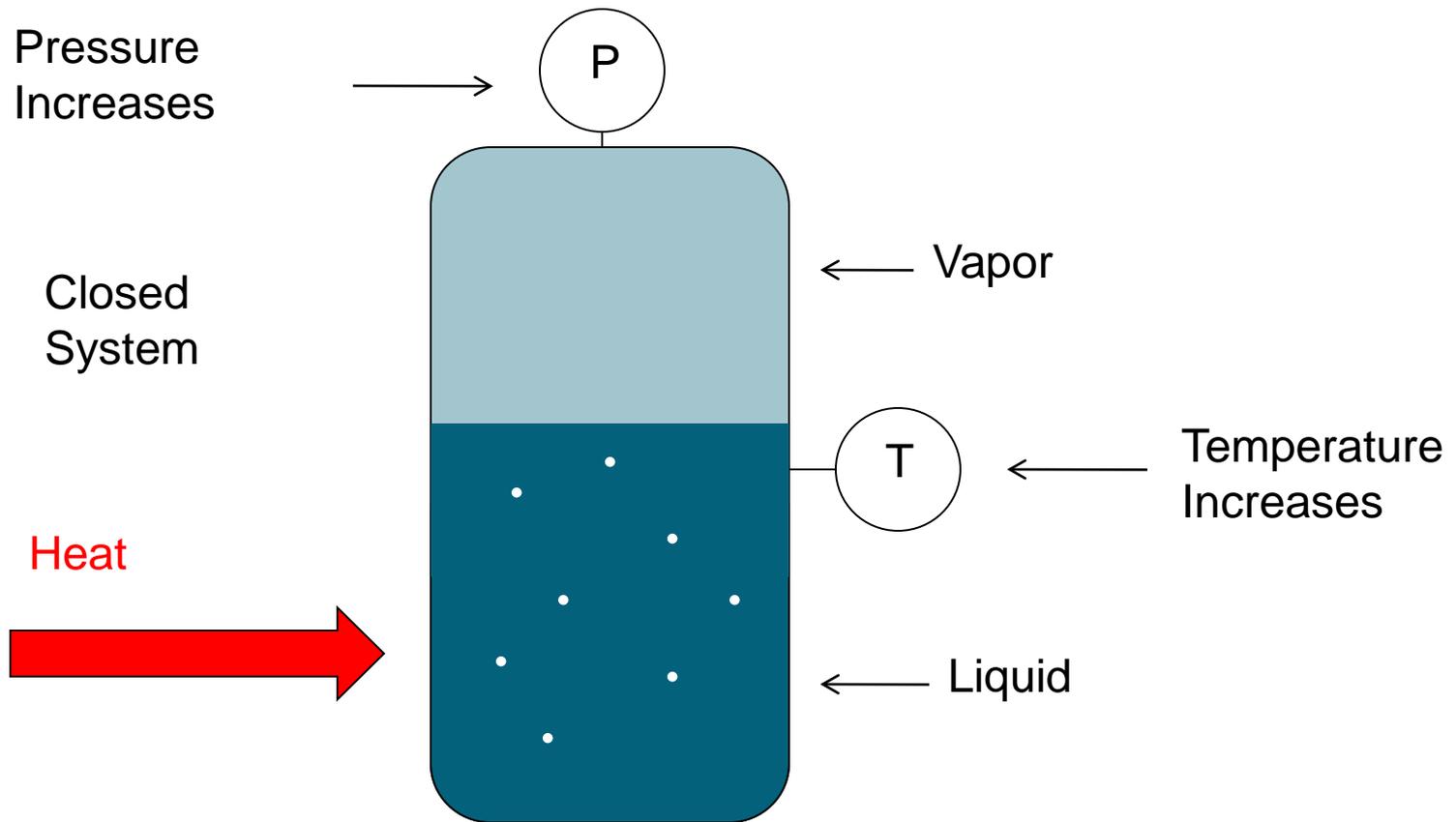
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Boiling Liquid Expanding Vapor Explosion, often referred to by the acronym BLEVE, is a phenomenon which occurs when a vessel containing a pressurized liquid substantially above its boiling point is ruptured, releasing the contents explosively.

- 1** Boiling
Liquid
- 2** Expanding
Vapor
- 3** Explosion



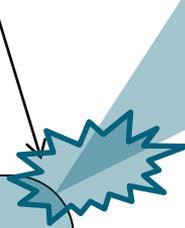
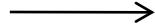
What Causes a BLEVE?



Pressure
Rapidly
Decreases

Vessel
Ruptures

P



← Vapor

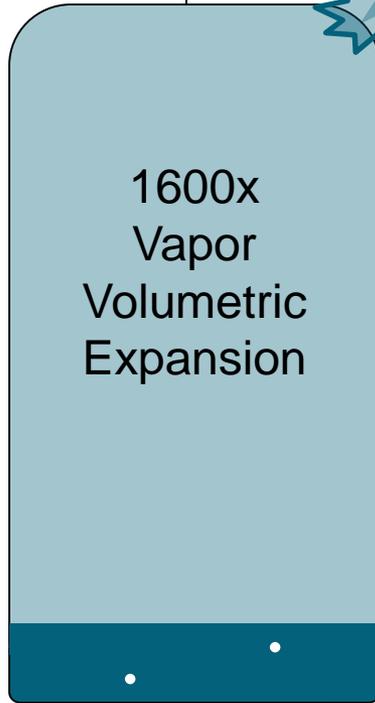
1600x
Vapor
Volumetric
Expansion

← Liquid
Flash
Vaporizes

Heat



← Liquid





Difference between BLEVE and Vapour Cloud Explosion

Kansas City
Gasoline Tank
explosion (1959)

Feysin (1966)



Mexico (1984)



Flixborough (1974)



Piper Alpha 1988



Pasadena



Vapour
Cloud
Explosions

ord 1998



BP Texas (2005)



Buncefield (2005)



VCE – typical Points

- ➔ Results from ignition of flammable mixture of vapour, gas, aerosol, or mist.
- ➔ Sudden or continuous release of large quantity of light hydrocarbons / flammable gases
- ➔ Some portion of gas must mix with air.
- ➔ Delayed ignition until a cloud of sufficient size has formed
- ➔ **Instant and widespread** damage to plant facilities & buildings due to blast pressure.
- ➔ Fatalities (mostly instant)
- ➔ Injuries (mostly serious)
- ➔ VCE followed by fire normally for substantial time

BLEVE – typical Points

- ➔ Results from catastrophic failure of a vessel containing a liquid at a temperature significantly above its boiling point at normal atmospheric pressure.
- ➔ Rapidly expanding vapour compresses the surrounding air, creating a blast wave
- ➔ Also, as vessel fails, fragmenting may occur.
- ➔ Vessel fragments can be propelled a significant distance high initial velocities.
- ➔ Commonly associated with releases of pressurized flammable liquids from vessels as a consequence of external fire.
- ➔ Can produce thermal radiation effects from a fireball, as well as blast and missile effects (rockets which can travel 2500 ft or more)
- ➔ Fragment from one BLEVE can initiate a BLEVE in the nearby second vessel

Transportation of Petroleum Products

- ▶▶ **TANK TRUCKS**
- ▶▶ **TANK WAGONS**
- ▶▶ **PIPELINE**
- ▶▶ **CARGO**

Transportation of Petroleum Products – Hazards due to Accidents

- ▶▶ **Fire (Flash / Pool / Jet Flame)**
- ▶▶ **Explosion (VCE / BLEVE)**
- ▶▶ **Toxic Release**
- ▶▶ **Loss of containment**
- ▶▶ **Can cause pollution**
- ▶▶ **Injury**
- ▶▶ **Fatality**
- ▶▶ **Loss of Property**

Pipeline Transportation

Advantages of Pipeline Transportation

- ▶▶ Loss in transit is less in pipeline transportation as compared to other modes
- ▶▶ Pipeline offers large-scale economies of scale in transportation liquid petroleum products
- ▶▶ Environmental impact during construction, operation and maintenance is negligible and reversible which is environment friendly
- ▶▶ It can be used to transport multiple products
- ▶▶ Pipeline transportation is flexible, as the volume transported can be increased/decreased quickly and at negligible cost
- ▶▶ Operation/maintenance costs are relatively lower

Road Transportation

- ▶▶ Road transportation is one of the significant mode of dispatch of petroleum products in Marketing Sector.
- ▶▶ This is an area where maximum accidents have occurred.
- ▶▶ According to the data, of the total accidents in Marketing Sector in the period of past 05 years, contribution of road transportation was 70%.

Causes of Accidents

- ▶▶ **Poor road condition.**
- ▶▶ **Bad weather.**
- ▶▶ **Lack of road discipline – overtaking, over speeding, application of sudden brake.**
- ▶▶ **Absence of approved parking place.**
- ▶▶ **Other slow moving transports.**
- ▶▶ **Human failures due to lack of training.**
- ▶▶ **Improper fittings on the Tank Truck.**
- ▶▶ **Mechanical failure due to poor maintenance.**
- ▶▶ **Driving in alcoholic condition**
- ▶▶ **Using Mobile phone while driving.**

Important Acts and Rules governing Road Safety

- ▶▶ The Motor Vehicles Act of 1988 with latest amendments;
- ▶▶ The Central Motor Vehicle Rules, 1989 with latest amendments;
- ▶▶ The Petroleum Rules, 2002 with latest amendments;
- ▶▶ The Public Liability Insurance Act, 1991 with latest amendments;
- ▶▶ The SMPV Rules of 1981 (UNFIRED) with latest amendments for LPG;
- ▶▶ OISD – RP – 157 - Recommended Practice for Transportation of Bulk Petroleum Products
- ▶▶ OISD – STD – 159 LPG Tank Trucks - Requirements of Safety on Design/Fabrication and Fittings
- ▶▶ OISD –STD – 160 - Protection to fittings mounted on existing LPG tank trucks
- ▶▶ OISD- GDN – 161 - LPG Tank Truck Incidents : Rescue & Relief Operations
- ▶▶ OISD – GDN – 165 - Guidelines for Rescue & Relief Operations for POL Tank Truck Accident
- ▶▶ OISD – RP – 167 - POL Tank lorry Design & Safety

Special Driving Skills

- ▶▶ **Defensive / Safe Driving**
- ▶▶ **Driving at Night**
- ▶▶ **Driving in the Rain**
- ▶▶ **Hill Driving**
- ▶▶ **Fog Driving**
- ▶▶ **Driving in Water Logged area**
- ▶▶ **Signaling**
- ▶▶ **Punctured Tyres**
- ▶▶ **Brake Failure**
- ▶▶ **Driving Under Alcoholic Conditions**

TREM CARD

- ▶▶ **TREM Card Stands for Truck Rescue Emergency Management Card for Road Transport. It gives information about the nature of hazard the product can cause and protective devices; what emergency action is required to be taken by the driver in the event of spillage / fire, and the First Aid to be given; and a list of Telephone numbers to be contacted in an emergency.**
- ▶▶ **It is compulsory that all drivers carry this card in the T/T and get themselves familiarised with the instructions in the card and act promptly whenever the emergency arises.**

TRANSPORT EMERGENCY CARD (ROAD)

Cargo : Liquefied Petroleum Gas

Nature of Hazard : Liquid under pressure and highly inflammable
Vapors – colorless, heavier than air and creep along the ground.
Heating of container will cause pressure rise and severe risk of explosion.
Gas causes nausea, breathlessness, and headache.
Contact with liquid can cause cold burns. Spilled liquid evaporates very rapidly
Air -Vapor mixture is highly explosive

Protective Devices : PVC / Synthetic gloves, Safety goggles, Self contained respiratory device.

EMERGENCY

If possible, try to move out the vehicle to an open area. Stop the engine. The vehicle should not be left unguarded.

Contact Police, Fire Brigade, Sarpanch, nearest Oil Company.

Keep public and traffic away from by displaying 'Danger' board at about 50 m. away.

No smoking and no naked lights in the cordoned off area. Stay upwind.

Spillage

Check the valve for tightness by hand and stop leak, if possible.

Fire

If minor, try to extinguish by DCP fire extinguisher.

First Aid

If eyes are affected, wash out with plenty of water. Remove contaminated clothing; wash affected parts with plenty of water. Seek medical help

Emergency Telephone Numbers

IOC/ HPC/ BPC/IBP-----

Fire Brigade : 101

Police : 100

सावधान !!!

1. शराब पीकर गाड़ी न चलाएं।
2. कृपया एल.पी.जी. वाहन के पास धूम्रपान न करें।
3. एल.पी.जी. वाहन को रोड साइड पर खड़ा करते समय पार्किंग लाइट्स को आन रखें।
4. किसी भी प्रकार की आग के पास वाहन को खड़ा न करें।
5. सड़क क्षेत्र पर कभी भी एल.पी.जी. वाहन को अकेला न छोड़ें।
6. एल.पी.जी. वाहन को हमेशा भीड़-भाड़ के क्षेत्र से दूर रखें।
7. एल.पी.जी. वाहन के नीचे न लेंटें।
8. एल.पी.जी. वाहन के नीचे खाना न बनाएं।
9. रिसाव होने पर या आग लगने पर नजदीकी पुलिस स्टेशन एवं फायर ब्रिगेड को सूचित करें।
10. यदि नींद लग रही हो या थिरा में हो तो गाड़ी को सड़क के किनारे सुरक्षित स्थान पर खड़ा करके आराम करें।



अग्नि व सुरक्षा विभाग

इण्डियन ऑयल कार्पो० लि०
इण्डेन बाटलिंग प्लांट

हरहुआ, वाराणसी (30 प्र०)
फोन : 0542-2622309, 2622310
फैक्स : 0542-2622311

इण्डेन बाटलिंग प्लांट इण्डियन ऑयल कार्पोरेशन लि०

हरहुआ, वाराणसी (30 प्र०)

Truck Rescue Emergency Management Card
(Road)

परिवहन आपात कालीन स्थिति कार्ड
(सड़क)

U.N. NO. 1075

यू. एन. नं. 1075

Hazchem Code 2WE

हैजकेम कोड 2 डब्ल्यू. ई



द्रवित पेट्रोलियम गैसेज
(एल.पी.जी.)

Liquidified Petroleum Gases
(L.P.G.)



इण्डियन ऑयल कार्पो० लि०
इण्डेन बाटलिंग प्लांट

हरहुआ, वाराणसी (30 प्र०)
फोन : 0542-2622309, 2622310
फैक्स : 0542-2622311

Indian Oil Corporation Ltd.
Indane Bottling Plant

Harahua, Varanasi
Phone : 0542-2622309, 2622310
Fax : 0542-2622311

सामान्य निर्देश

भौतिक गुण

1. यह एक रंगहीन गैस है।
2. स्वप्रज्वलन तापमान - 410° से.
3. विस्फोटक सीमा - 1.8 से 9.5 प्रतिशत
4. वाष्पघनत्व - 1.5 से 2 (हवा-1)
5. वाष्पदाब - 16.8 किग्रा०/से० 65 से. तापमान पर

खतरे की प्रकृति-

1. अल्पधिक ज्वलनशील, रंगहीन एवं दबाव से तरल।
2. वाष्प (गैस) दिखाई नहीं देती, हवा से भारी होती है और जमीन के साथ-साथ चलती है।
3. आस पास के गड़दो, नालियों, मेनहोल में जमा हो जाती है।
4. वायु के साथ विस्फोटक मिश्रण बनाती है।
5. गर्म होने पर दाब बढ़ जाता है, जिसके कारण फटने के साथ विस्फोट का खतरा हो जाता है।
6. वाष्प में नशीला प्रभाव होता है, ज्यादा सूँघने पर सांस में तकलीफ, उल्टी, सिर चकराने की शिकायत हो सकती है।
7. आँखों और श्वास नलिका में जलन हो सकती है।
8. आग में विघटील होकर जहरीला धुँवा छोड़ती है। जिसके लक्षण कई घण्टे बाद भी प्रकट हो सकती हैं।
9. लिकेज होने पर घाइप, वाष्प या फ्लेन्ज के चारो ओर बर्फ जमा हो सकती है।
10. द्रव एल.पी.जी. त्वचा से छूने पर त्वचा जल सकती है।

सुरक्षा के साधन -

एल.पी.जी. के रिसाव को रोकने समय प्रयोग करें।

- (क) प्लास्टिक या रबड़ के दस्ताने।
- (ख) आँखों को पूर्ण सुरक्षा देने वाले चश्मे।
- (ग) श्वसन यंत्र (अधिक वाष्प वाले क्षेत्रों में)
- (घ) आँख धोने के लिए श्वच्छ जल

गैस के रिसाव/बिखराव की दशा में -

1. वाहन को तुरन्त खुले स्थान पर ले जावें।
2. वाहन को आबादी वाले क्षेत्र से दूर ले जावें।
3. इंजन को बन्द करें बैटरी के तार हटा दें।
4. सड़क पर खतरे का बोर्ड चारो तरफ लगा दें।
5. वाहन के दोनो तरफ कम से कम 300 मीटर तक गाड़ियों का आवागमन रोक दें तथा गुजरने वाले वाहन तथा व्यक्तियों को सावधान करें।
6. धुप्रपान न करें, माधिस तथा लाइट न जलायें। यदि उपलब्ध हो तो पानी का छिड़काव करें।
7. यदि खतरा न हो तो वाल्व को तुरन्त बन्द करें।
8. यदि गैस सेपटी वाल्व से रिस रही है और वाल्व पुनः स्थापित नहीं हो रहा है तो लकड़ी से आराम से मार कर वाल्व पुनः स्थापित करें।
9. यदि वाल्व टूट गया है तो सेपटी किट से कोई लकड़ी का टुकड़ा निकाल कर उसे वाल्व के स्थान पर फिट करें।
10. रिसाव को बालू या मिट्टी से इकट्ठा कर लें और इसको सुरक्षित निपटाने हेतु विशेषज्ञ की सलाह लें।
11. आपात काल के समय दिये गये नम्बरों पर सम्पर्क करें।

छोटी आग लगने पर -

1. रिसाव को बन्द करें, आग को पानी से ठंडा करें।
2. यदि रिसाव तुरन्त बन्द नहीं कर सकते हैं तो आग को जलने दें।
3. ड्राई केमिकल पाउडर व कार्बनडाई आक्साइड फायर एक्सटिंगुअर का प्रयोग करें।
4. बुलेट को पानी की फुहार से ठंडा करें।
5. यदि आग वाल्व से है तो वाल्व के आस-पास का क्षेत्र पानी की फुहार से ठंडा करें।
6. आस पास के लोगों को सूचित करें।

बड़ी आग लगने पर-

1. आस-पास करीब 1 किमी. का क्षेत्र खाली कर दें।
2. टैंकर को पानी की फुहार से ठंडा करें।
3. पानी को टैंकर के साइड पर छिड़किये।
4. यदि आग वाल्व से है। तो सीधा जेट वाल्व पर कभी मत मारिये।
5. बड़ी आग में मानव रहित होज होल्डर या मानीटर नोजल का प्रयोग करें।
6. यदि सेपटी वाल्व से गैस निकलने की आवाज बढ़ती हुई मालूम हो तो तुरन्त दूर चले जायें।
7. नजदीकी पुलिस स्टेशन, फायर स्टेशन, पेट्रोल पम्प आई. ओ. सी./डी.पी.सी./एच.पी.सी. के एल.पी.जी. प्लान्ट को सूचित करें।
8. यदि वाल्व बन्द हो गया है और रिसाव नहीं हो रहा है तो डी.सी.पी. फायर एक्सटिंगुअर का प्रयोग करें।
9. प्रेशर गेज का प्रेशर यदि लगातार बढ़ रहा हो तो तुरन्त दूर चले जायें।

प्राथमिक उपचार -

1. संदूषित कपड़ों को तुरन्त हटा दें और प्रभावित त्वचा को साबुन और पानी से धो दें।
2. यदि आँखें प्रभावित हुई हैं तो कम से कम 15 मिनट साफ पानी से धोयें और चिकित्सा की सलाह लें।
3. यदि सांस लेने में दिक्कत हो रही है तो खुली हवा में नीचे लेट जायें और शान्ति से धीरे-धीरे सांस लें।

आपात कालीन स्थिति में सम्पर्क करें -

नजदीकी पुलिस स्टेशन - फोन : 100

नजदीकी फायर स्टेशन - फोन : 101

नजदीकी आई. ओ. सी. / डी.पी.सी./एच.पी.सी. प्लान्ट, पेट्रोल पम्प।

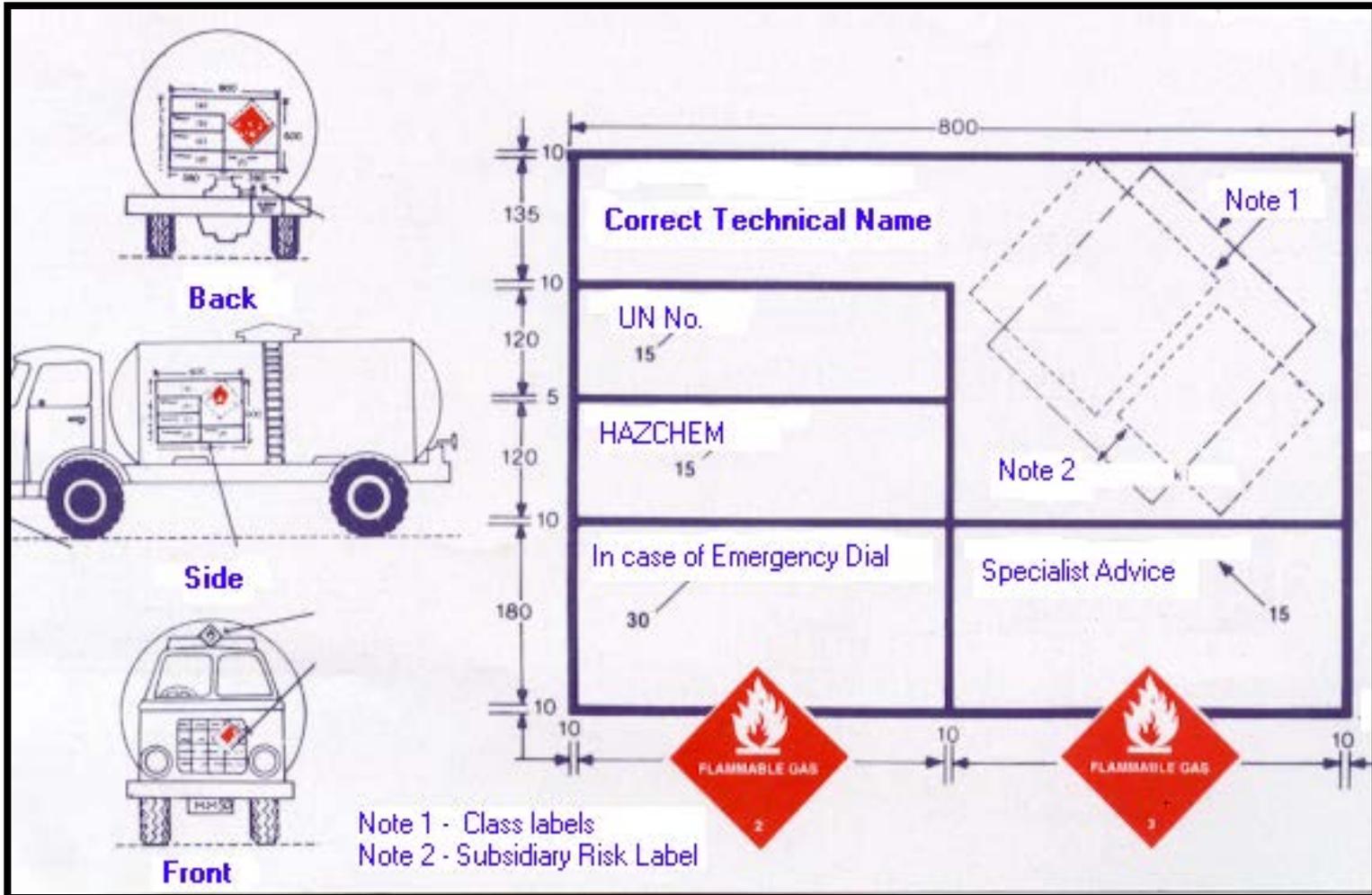
इण्डियन ऑयल कार्पो० लि० इण्डेन बाटलिंग प्लांट

हरहुआ, वाराणसी (30 प्र०)
फोन : 0542-2622309, 2622310
फैक्स : 0542-2622311

Class Labels and Emergency Information Panel

A TT must have a Class Label and Emergency Information Panel (EIP) painted as per MV Act. Where as EIP must be painted as per specifications on the rear and both side of the TT, class label must be painted on the cabin top and front cover of the engine. EIP and class label should be clearly visible from outside.

Emergency Information Panel



HAZCHEM code and UN No

Product	UN Number	HAZCHEM Code		
LPG	1075	2	W	E
NAPHTHA	1255	3	Y	E
MS	1203	3	Y	E
SK	1223	3	Y	
HSD	1202	3	Y	E
FO	1270	3	Y	E
CRUDE OIL	1267	2	W	E

Do's and Don'ts to avoid hazards during transportation by road

- ▶▶ All wiring of vehicle should be checked regularly.**
- ▶▶ A thorough check should be made of any wiring which has been in contact with the load (due to possibility of insulation failure).**
- ▶▶ The fire extinguisher should be regularly checked and serviced and should not be chain locked.**
- ▶▶ The tanker should carry portable road barriers.**
- ▶▶ The driver should walk round the vehicle at least 2 hours to check the pressure and temperatures of the product, to see that no leaks have developed and to check temperature of the hubs and tyres or to spot any other abnormality in the vehicle.**

Do's and Don'ts to avoid hazards during transportation by road

- ▶▶ **The drivers should be told to stop the vehicle and telephone for advice if there is the slightest sign of overheating.**
- ▶▶ **The drivers should make sure that a competent person is doing the unloading operation at the receiving end.**
- ▶▶ **While delivery is taking place, the driver or the attendant must keep a constant watch on the vehicle.**
- ▶▶ **The engine must be stopped before commencement of loading.**
- ▶▶ **The tank-truck should be properly earthed before commencing discharge (unloading).**
- ▶▶ **The driver must not allow anybody other than a responsible man nominated by the company to drive the vehicle. Drivers should have valid driving license.**

Do's and Don'ts to avoid hazards during transportation by road

- ▶▶ **Anyone engaged in loading, unloading and conveyance of dangerous liquid and gases must take all the precautions for preventing fire or explosion and must ensure as far as reasonably possible all liquid escapes into any sewer or drain.**
- ▶▶ **Any one attending the vehicle which is carrying flammable or combustible products is forbidden :**
 - **To smoke**
 - **To carry matches**
 - **To carry artificial lights capable of ignition**
 - **To carry anything capable of causing fire and explosion**
- ▶▶ **The driver should make sure that all the labels written on the tanker are clean and legible.**
- ▶▶ **The driver should carry the transport emergency card (TREM Card); of the product which is loaded in the tanker/truck.**

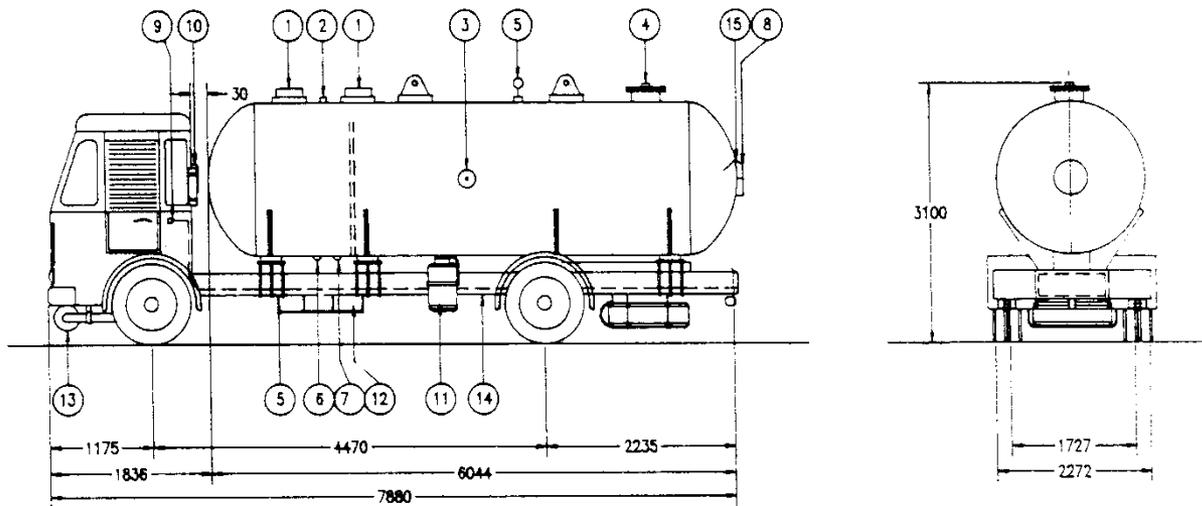
Do's and Don'ts to avoid hazards during transportation by road

- ▶▶ **The driver, before starting the loading or unloading should put the wheel arresting blocks (wheel chocks) on all the wheels.**
- ▶▶ **The vehicle should be equipped with a First-Aid Box and personal protective equipment as prescribed in “TREM Card”.**
- ▶▶ **Vehicles should always be parked in safe place and guarded by the driver or the cleaner so that nobody tampers with vehicle or the product.**
- ▶▶ **In case of an accident, the vehicle should, as far as practicable, be moved to a safe location to prevent other vehicles from colliding with it.**
- ▶▶ **Member of the public should be kept away from the accident site and in case of leakages, sources of ignition should be extinguished and if necessary, public should be evacuated to safer place.**



Tank Trucks Safety Fittings

GENERAL ARRANGEMENT OF LPG TANK LORRY (6 T. CAPACITY)



1. SAFETY RELIEF VALVES FOR VESSEL

2. ULLAGE GAUGE

3. ROTOGAUGE

4. MANHOLE

5. PRESSURE GAUGE WITH EXCESS FLOW VALVE

6. LIQUID INLET/OUTLET BYPASS LINE VALVES WITH EXCESS FLOW CHECK VALVES

7. VAPOUR RETURN LINE VALVE WITH EXCESS FLOW CHECK VALVE

8. MARKING PLATE

9. MASTER CUT-OFF SWITCH

10. FIRE EXTINGUISHER (DRY POWER CHEMICAL)

11. FIRE EXTINGUISHER (DRY POWDER)

12. FUEL TANK WITH STEEL GUARD

13. FLAME TRAP

14. WIRING FOR TAIL LIGHT IN CONDUIT PIPE

15. WELL FOR THERMOMETER

DESIGN PRESSURE - 15.96 kg/cm²

HYDRAULIC TEST PRESSURE - 29.94 kg/cm²

DESIGN TEMPERATURE - 55°C

RADIOGRAPHY 100% STRESS RELIEVING REQUIRED

EMPTY WEIGHT - 3814 kg.

WATER CAPACITY - 12662 Lbs.

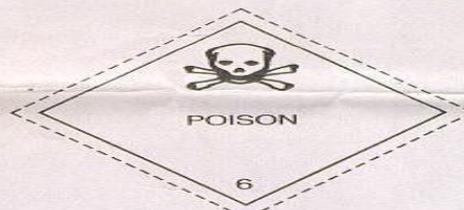
DESIGN CODE ASME SECT. VII DIV.1 LATEST EDITION.

Safety Fittings on a LPG Bullet

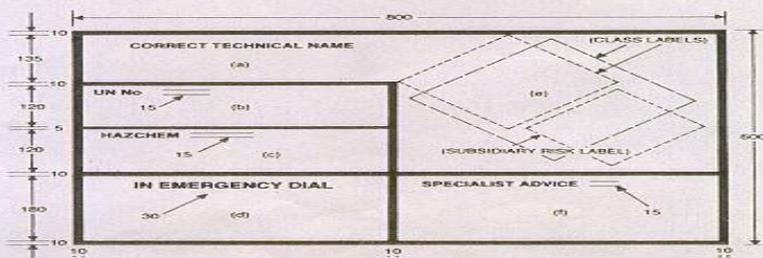
- ▶▶ **Safety Relief Valve** – ensures the release of pressure in excess of set pressure.
- ▶▶ **Excess Flow Check Valve** - valve shuts off if the flow exceeds the set limit
- ▶▶ **Roto-Gauge** - measures the volume of LPG in a bullet in terms of percentage.
- ▶▶ **Master Cut-Off Switch** - isolates the battery connection from all electrical components of the Bullet.
- ▶▶ **Fire Extinguishers**
- ▶▶ **Spark Arrestor**
- ▶▶ **Electrical Wiring / Electrical System**

SYMBOLS FOR TRANSPORT OF DANGEROUS GOODS BY ROAD

CLASS LABELS



EMERGENCY INFORMATION PANEL FOR GOODS CARRIAGE



Transportation By Rail

The Railways Red Tariff Rules, 1960 under Indian Railways Act 9 of 1890 lays down the procedure and stipulates conditions for the carriage by rail of dangerous goods except explosives for Defence Services.

Transportation By Rail

Salient features of the regulations are:

- ▶▶ **Dangerous goods are classified into seven categories, i.e.**
 - ✓ **Explosives**
 - ✓ **Gases –compressed, liquefied or dissolved under pressure**
 - ✓ **Petroleum and other inflammable Liquids,**
 - ✓ **Inflammable solids**
 - ✓ **Oxidising Substances**
 - ✓ **Acids and Other Corrosives**
 - ✓ **Poisonous (Toxic) Substances.**
- ▶▶ **Separate dealing for each group.**
- ▶▶ **No hazardous goods other than listed will be accepted.**
- ▶▶ **Loading / unloading of these goods will be done by Consignee.**
- ▶▶ **Quantity to be loaded in accordance with prescribed norms only.**
- ▶▶ **Precautions, as given in the regulations to be observed during handling and storage.**
- ▶▶ **For petroleum products, advance confirmation of readiness to accept goods on arrival is necessary.**
- ▶▶ **Dangerous goods to be removed fast from the premises**



Tank Wagon Safety Fittings

Tank Wagon Safety Fittings

Tank wagons for LPG (Railway Code TG) (4 wheeler/8 Wheeler)

- ▶▶ Provided with safety valve with Discharge Capacity of 10.3 cum/sec.
- ▶▶ All other fittings such as liquid valves, vapour valves, magnetic gauging device, thermo-well, sampling valve and safety valves, pressure gauges are provided on the top of the pressure vessel in a protective housing known as 'dome' with a cover.
- ▶▶ For repairs & maintenance, tank wagons are to be degassed by filling water.
- ▶▶ While commissioning tank wagons are required to be purged with LPG/inert gases.



THANK YOU



Safety Checks at ALDS

Safety Checks at ALDS

- ▶▶ TT to be unloaded during non peak hours at location approved by CCOE.
- ▶▶ Un loading to be done in presence of authorized person & TT crew.
- ▶▶ 2 no. 10 Kg FE to be kept in readiness.
- ▶▶ TT to be placed in drive out position.
- ▶▶ Master cut off switch of TT to be kept in off position
- ▶▶ Wooden Stoppers(Chokers) to be placed under wheels.
- ▶▶ TT to be bonded.
- ▶▶ LPG level in the storage tank to be monitored regularly.

Safety Checks at ALDS

During TT decantation process

- ▶▶ Ensure bobtail entering the ALDS for decantation is fitted with Spark Arrestor.
- ▶▶ Ensure Bobtail is parked / Positioned on the demarcated area only.
- ▶▶ Bobtail should be earthed to the additional earthing point provided near fill point.
- ▶▶ Ensure all body valves on the Bobtail and Fill Point are closed.
- ▶▶ Connect the Liquid & vapour Quick Release Couplings on the Fill Point first and then on the Bobtail.
- ▶▶ Open the Remote Operated Inlet Valves mounted on the tank.
- ▶▶ Ensure that the flow meter on the bobtail is re-set to Zero.
- ▶▶ Engage the PTO on the Bobtail for operation of Hydraulic Pump.

Safety Checks at ALDS

Earthing

- ▶▶ Check the earthing connections and condition of earthing of panel/ pump motor skid etc.
- ▶▶ Check the jumper of LPG pipe line.
- ▶▶ Pour the water into earthing pit every month
- ▶▶ Check the condition of grounding electrode

Maintenance Agency: Manufacturer of Equipment /owner

Safety Checks at ALDS

Panel

- ▶▶ Check the condition of panel
- ▶▶ Check the condition of indicator
- ▶▶ Check the flame proof fitting & junction box
- ▶▶ Check the condition of cable duct & wiring
- ▶▶ Check the voltage of Panel RYB

Agency: RO Pump operator

Safety Checks at ALDS

Storage area

- ▶▶ Check any visible sign of leakage with explosive meter
- ▶▶ Check for vegetation (dry grass leaves) to be removed
- ▶▶ Check the house keeping
- ▶▶ Clean and check the condition of all valves, metering equipments, temperature & pressure gauge and other equipments installed within yard and on the Dispenser
- ▶▶ Check the temperature and pressure daily before starting the sale
- ▶▶ Check the compressor FRL unit daily
- ▶▶ Check the compressor pressure
- ▶▶ Drain the water air receiver every after 15 days.

Agency: RO Pump operator

Safety Checks at ALDS

Dispensing

- ▶▶ Check the EPB working and ROV operation every day
- ▶▶ Check the condition of nozzle, jaws swivel joints
- ▶▶ Check the condition of dispensing hose pipe before first filling.
- ▶▶ Check for cuts, worn spots or kinked area on the hose pipe daily
- ▶▶ Check the condition and portion of fire extinguisher
- ▶▶ Check the availability of the first aid box
- ▶▶ Check the dispensing pressure of dispenser and submersible pump.
- ▶▶ Check the excessive noise and abnormal vibration of submersible pump, if any, during dispensing.

Agency: RO Pump operator

Safety Checks at ALDS

Decanting

- ▶▶ Check the EPB/ESD & ROV's functioning
- ▶▶ Check the fill point to tank line
- ▶▶ Check the level of storage tank and tanker
- ▶▶ Check the temperature of storage tank and tanker
- ▶▶ Dispensing should be stopped during unloading
- ▶▶ Other fuel should not be decanted while unloading of LPG is on
- ▶▶ Decanting hose pipe to be kept into PVC pipe with end caps.

Agency: RO Pump operator

Safety Checks at ALDS

At the end of day

- ▶▶ Check and note down level gauges.
- ▶▶ Check and note down the dispenser mechanical totaliser reading.
- ▶▶ Dispenser hose should be positioned properly and filling gun should be kept into holder.
- ▶▶ Shut off the compressor valve
- ▶▶ Switch of the panel and switch of the main supply

Agency: RO Pump operator



Emergency Handling Procedures at ALDS

Emergency Handling Procedures at ALDS

Spill or Leak

- ▶▶ Shut off engine and any electrical equipment and leave 'off' until vapour hazard is removed.
- ▶▶ If available, use outside 'Emergency Stop' handles.
- ▶▶ No smoking or naked lights within 70 m.
- ▶▶ Move people from the area, move upwind.
- ▶▶ Avoid breathing vapour and contact with liquid or gas.
- ▶▶ Spray water to disperse gas cloud but avoid spraying water directly on leaking containers as this will increase leakage.
- ▶▶ Prevent spillage from spreading or entering underground drains by banking with sand or earth.
- ▶▶ Don't start the vehicle engine or other engines and don't operate electrical equipment in the area.
- ▶▶ Inform the fire brigade and police.

Emergency Handling Procedures at ALDS

Fire

- ▶▶ Shut off engine and any electrical equipment and leave 'off' until vapour hazard is removed.
- ▶▶ Move people from the area, move upwind.
- ▶▶ Send messenger to inform the fire brigade and police. Tell them location, material and quantity.
- ▶▶ Attempt to cut off source or gas rather than put out fire.
- ▶▶ Remove containers from vehicle if not in area of fire, or remove other material to prevent spread of fire to containers.
- ▶▶ If fire gets out of control, evacuate area and warn against entry.

Emergency Handling Procedures at ALDS

Tanker / Vehicle Accident

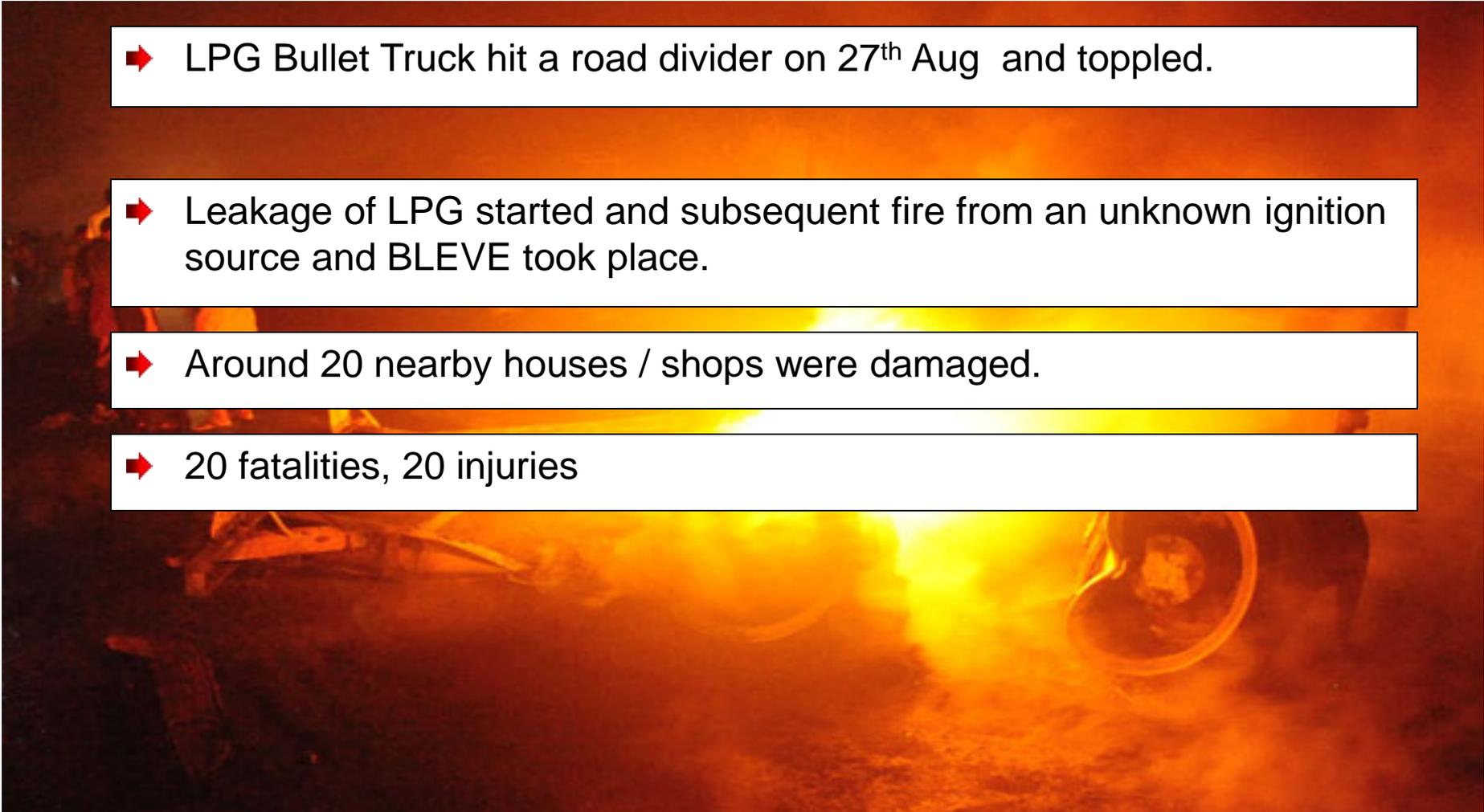
- ▶▶ Shut off engine and any electrical equipment and leave 'off' until vapour hazard is removed.
- ▶▶ Move people from the area, move upwind.
- ▶▶ Check for spills or leaks.
- ▶▶ Send messenger to inform the fire brigade and police. Tell them location, material and owner. Indicate condition of vehicle and any damage observed.
- ▶▶ Don't start the vehicle engine or other engines and don't operate electrical equipment in the area.
- ▶▶ If tanker is on fire, evacuate area and warn against entry.



Major LPG Transportation Accidents

Road Accident At Kannur

- ➡ LPG Bullet Truck hit a road divider on 27th Aug and toppled.
- ➡ Leakage of LPG started and subsequent fire from an unknown ignition source and BLEVE took place.
- ➡ Around 20 nearby houses / shops were damaged.
- ➡ 20 fatalities, 20 injuries



Road Accident At Kannur



Road Accident At Kannur



Road Accident At Kannur



Road Accident At Kannur



LPG TT BLEVE and Fire at Baghpat, UP on 18.09.14

- ❖ Loaded LPG TT met with an accident and caught fire near Baghpat, UP.
- ❖ When the driver was taking a turn, TT hit a nearby 11 KVA pole and energized line fell on the TT causing fire.
- ❖ Cause: TT Driver was in drunken condition.
- ❖ Total product was lost and the TT also got burnt completely.
- ❖ There was no casualty. However around 10-12 buffaloes and 5-6 houses have got burnt.
- ❖ TT driver is hospitalized & cleaner not traceable.

LPG TT BLEVE and Fire at Baghpat, UP on 18.09.14



LPG TT BLEVE and Fire at Baghpat, UP on 18.09.14



Explosion of Tanker in Uganda – Jun 29, 2013



Explosion of Tanker in Uganda

- ▶▶ **A car crashed into a moving gas tanker, sparking a fire that killed at least 33 people and left another 29 people badly burned in Uganda on June 29, 2013.**
- ▶▶ **The gas tanker exploded after colliding with a passenger car causing a leak on the outskirts of the Ugandan capital, Kampala.**
- ▶▶ **Most of the dead were passenger motorcyclists who had tried to siphon gas from the tanker after the driver abandoned it.**
- ▶▶ **Moments later the tanker burst into flames, engulfing nearby cars and scores of people.**
- ▶▶ **Investigators concluded that the crash was an accident.**

Explosion of Tanker in Uganda



Explosion of Tanker in Uganda



Explosion of Tanker in Uganda



Oil Tanker Fire in Gainford – Oct 19, 2013



Oil Tanker Fire in Gainford

- ▶▶ **13 cars, four carrying petroleum crude oil and nine loaded with LPG of Canadian National Tanker Train derailed at around 1am local time in the hamlet of Gainford, about 50 miles from Edmonton on Oct 19, 2013.**
- ▶▶ **Three cars began leaking and caught fire.**
- ▶▶ **Residents of Parkland County reported seeing a fireball shoot across the sky after one of the cars carrying liquefied petroleum gas exploded.**
- ▶▶ **No one was injured and nearby areas were immediately evacuated.**

Oil Tanker Fire in Gainford



Oil Tanker Fire in Gainford



Oil Tanker Fire in Gainford



Oil Tanker Fire in Gainford



Oil Tanker Fire in Gainford





Thanks

Cloudburst in Mandi distt, Himachal, 2015.



Earthquake in Mandi distt, Himachal, 2015.



Flood in Kinnaur District, Himachal, 2013.

(>5500 deaths)



Uttarakhand flood in 2013.



Uttarakhand flood in 2013.



Uttarakhand flood in 2013.



Uttarakhand flood in 2013.

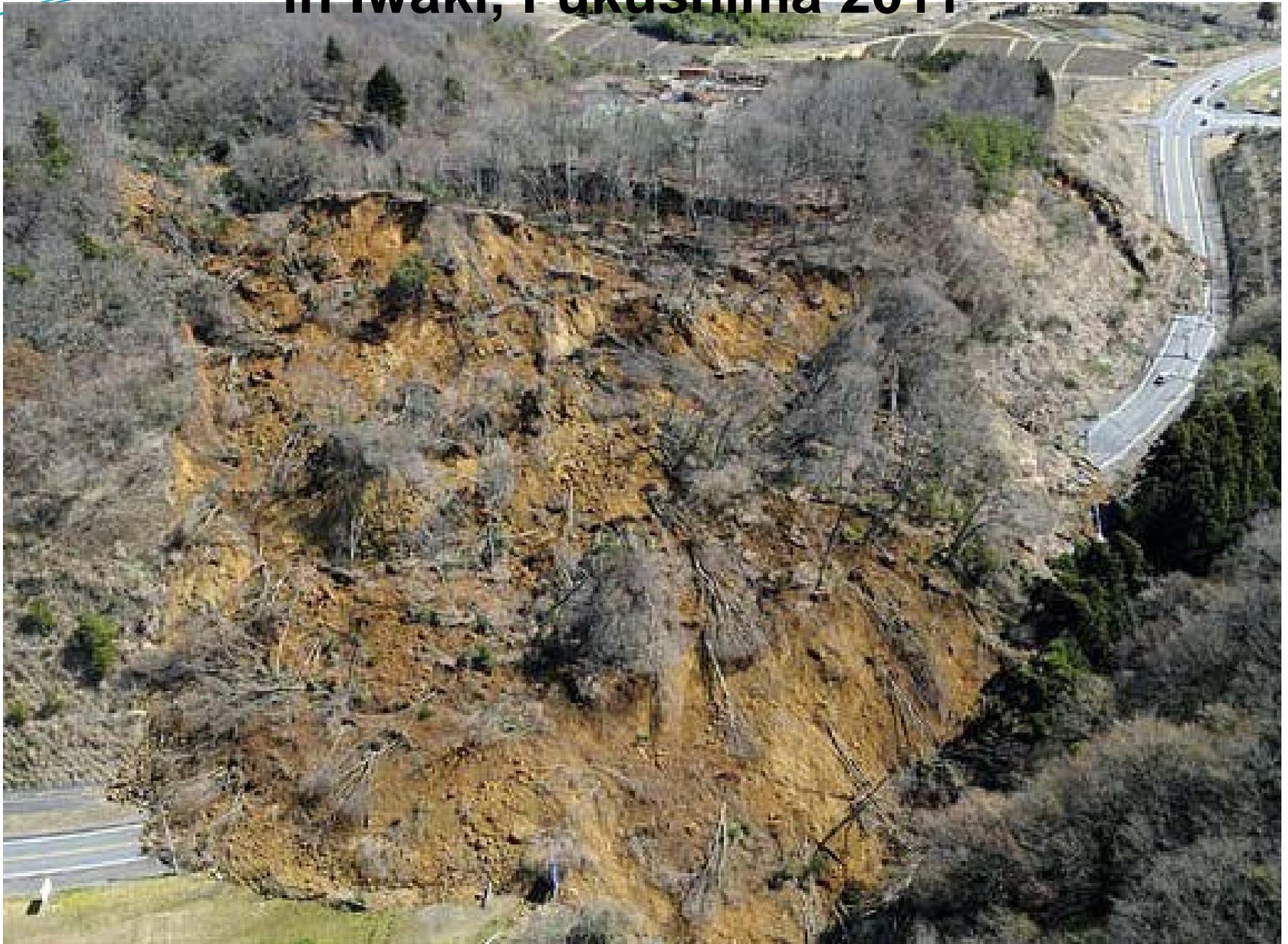


People look at a collapsed road and the flooded river in Uttarakhand.

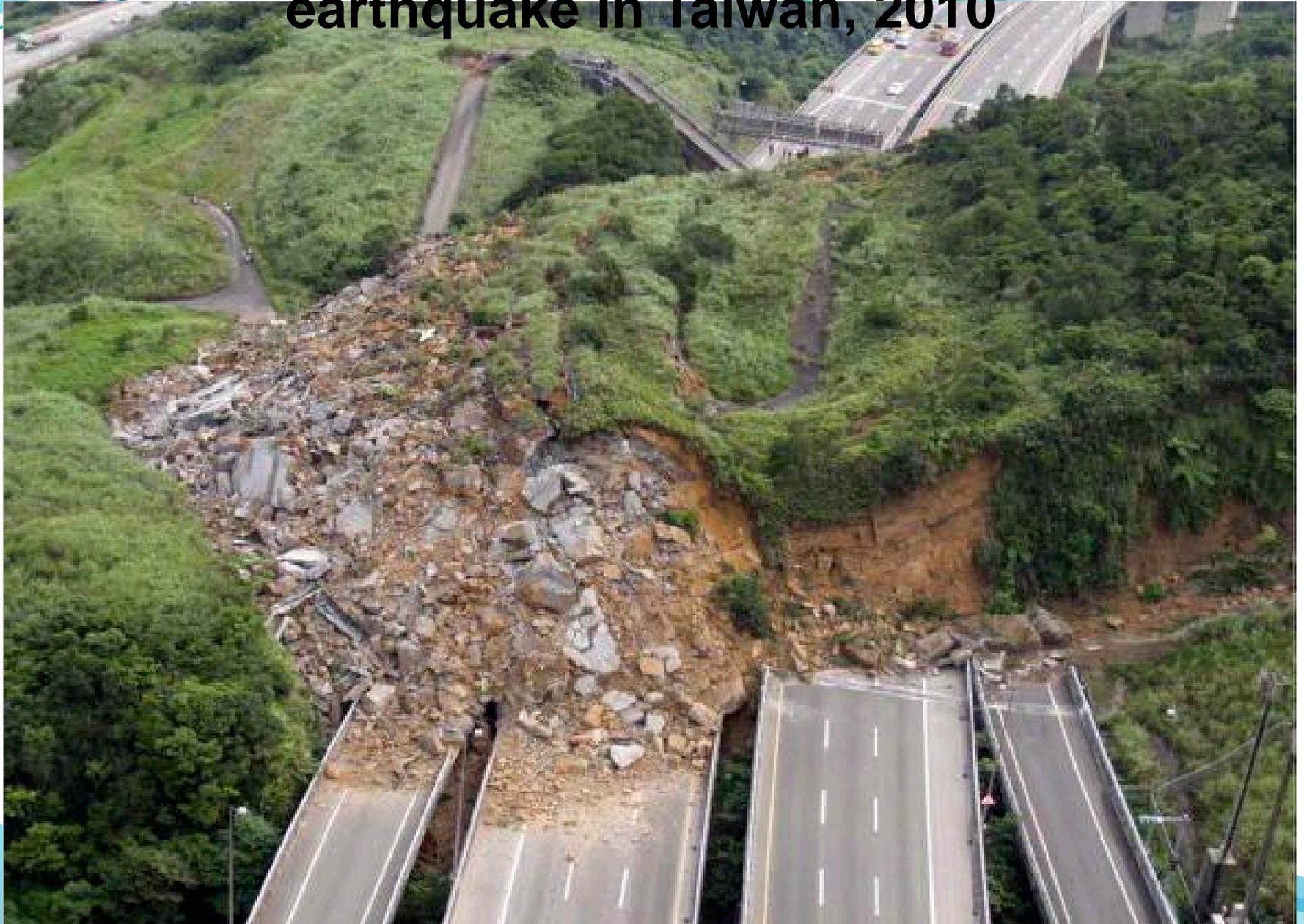
Kashmir flood in 2015



Landslide caused by a magnitude-7.0 earthquake in Iwaki, Fukushima 2011



Landslide caused by a magnitude-6.8 earthquake in Taiwan, 2010



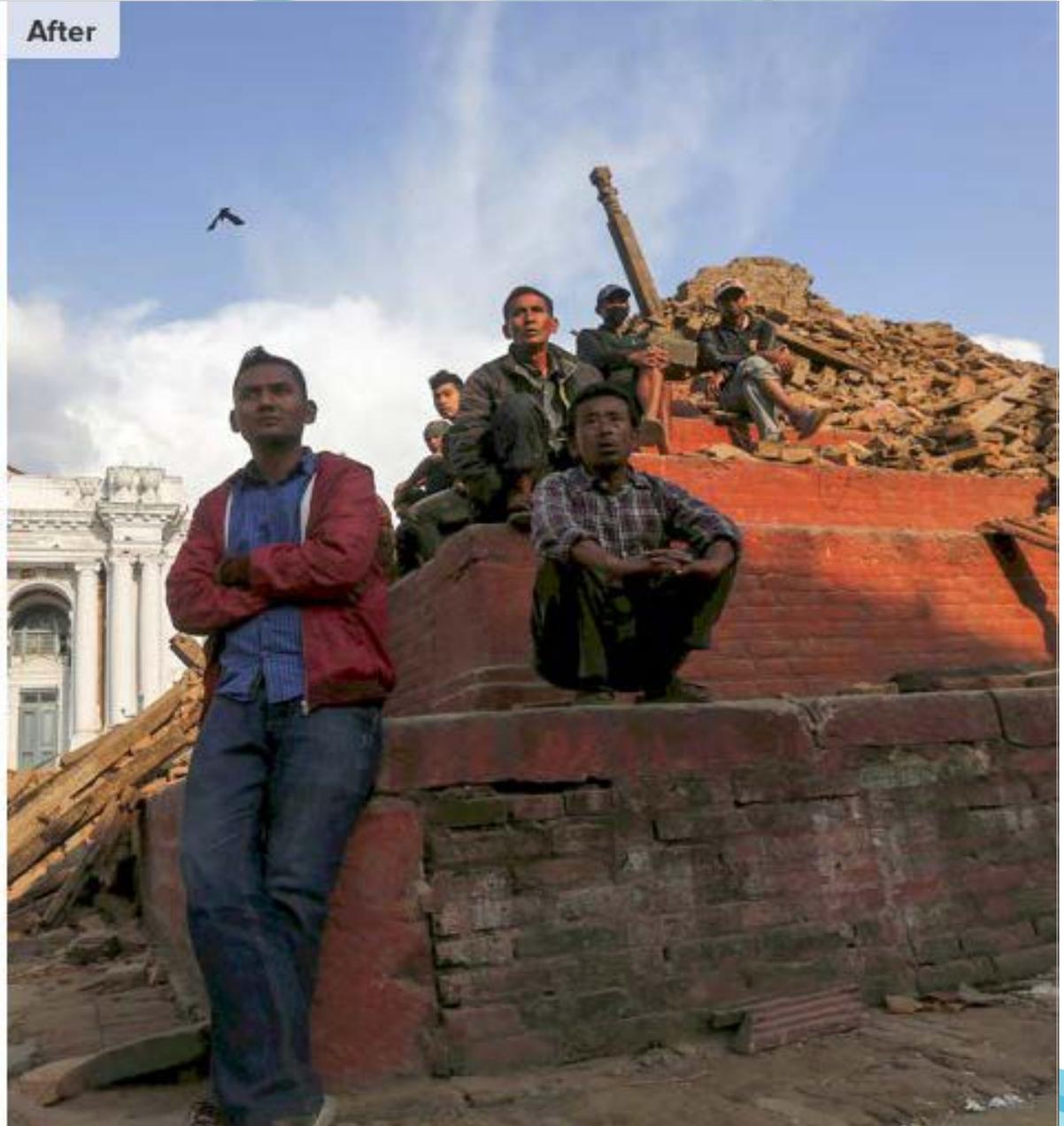
Landslide in Darjeeling



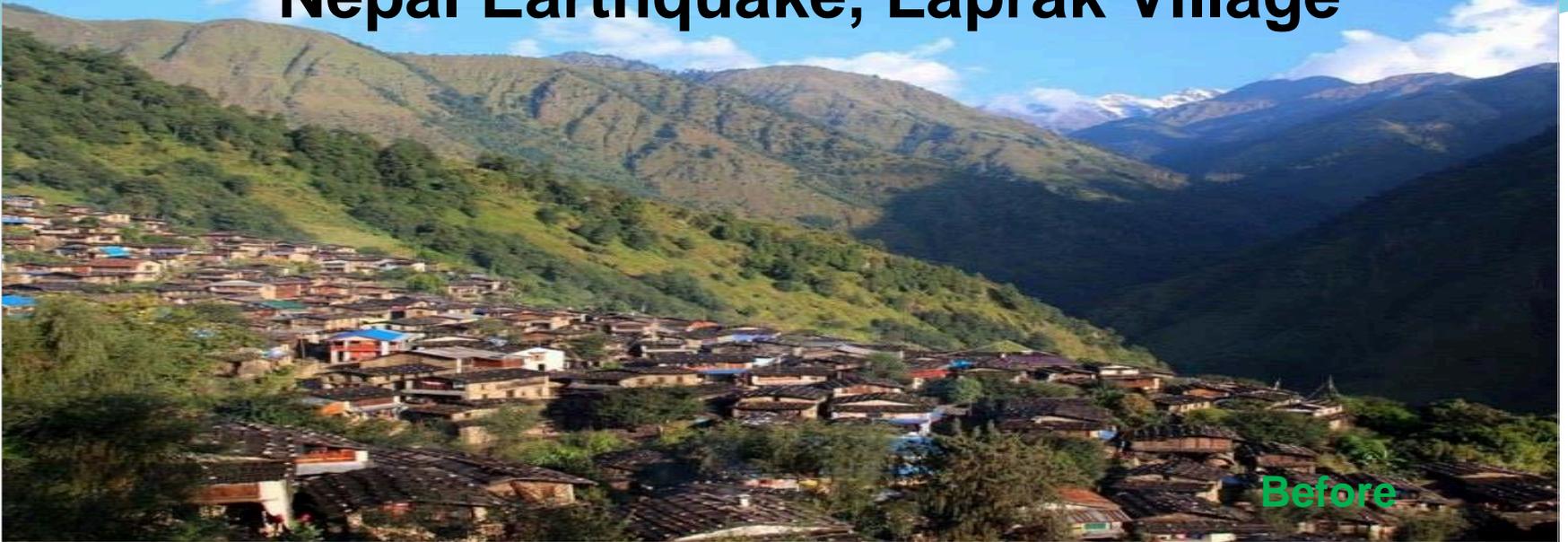
Landslide in Pune, Maharashtra 2014



Nepal Earthquake



Nepal Earthquake, Laprak Village

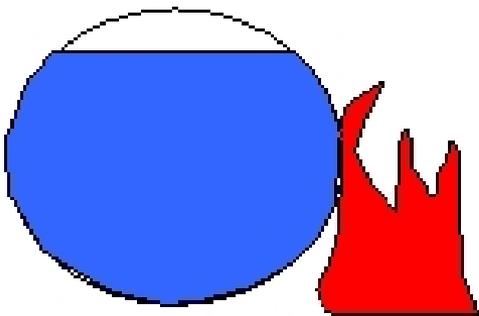


Auto ignition, flash point and explosive limits of some of the petroleum products

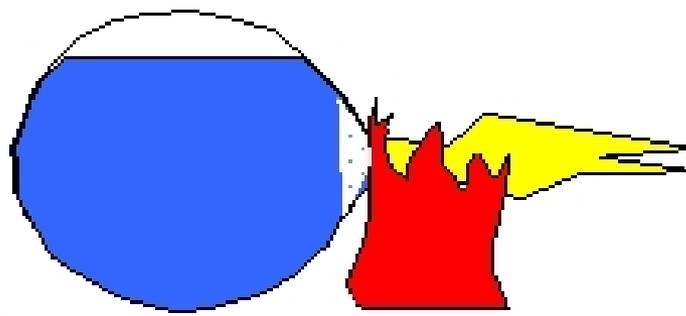
S. NO.	MATERIAL	AUTO IGNITION TEMPERATURE oC	FLASH POINT oC	EXPOSING RANGE VOLUME % IN AIR	
				LOWER LIMIT	UPPER LIMIT
1	CRUDE OIL	DEPENDS UPON THE NATURE OF CRUDE	19	DEPENDS UPON THE NATURE OF CRUDE	
2.	HYDROGEN	585	GAS	4.1	74.0
3	METHANE	538	GAS	5.0	15.0
4	ETHANE	514	GAS	3.0	12.5
5	PROPANE	466	GAS	2.4	9.5
6	BUTANE	430	GAS	1.5	9.0
7	BENZENE	563	-11	1.3	7.1
8	TOLUENE	536	4.5	1.2	7.2
9	NAPHTHA	288	-18	1.1	5.9
10	GASOLINE	245	-7	1.4	7.6
11	ATF	254.4	38	0.7	5
12	SKO	254	35	0.7	5

Auto ignition, flash point and explosive limits of some of the petroleum products

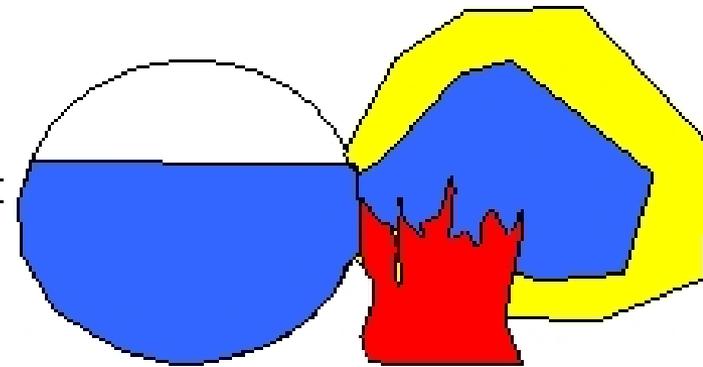
S. NO.	MATERIAL	AUTO IGNITION TEMPERATURE	FLASH POINT °C	EXPOSING RANGE VOLUME % IN AIR	
				LOWER LIMIT	UPPER LIMIT
13	HSD	256	32	0.7	5
14	LDO	-	66	-	-
15	LSHS	316	66-166	-	-
16	HSHS	-	65.6-148.9	-	-
17	FO	262-407	-	-	-
18	BITUMEN	485	205	-	-
19	RAW COKE	-	315.6	-	-
20	PHENOL EXTRACT	715	80	-	-
21	SLACK WAX	245	198.9	-	-
22	MINERAL TURPENTINE OIL	253.3	32.2	-	-
23	LPG	405-450	GAS	1.8	9.6



External fire plays directly on liquefied gas vessel.



Liquid boils enabling a part of the vessel to heat up and rupture.

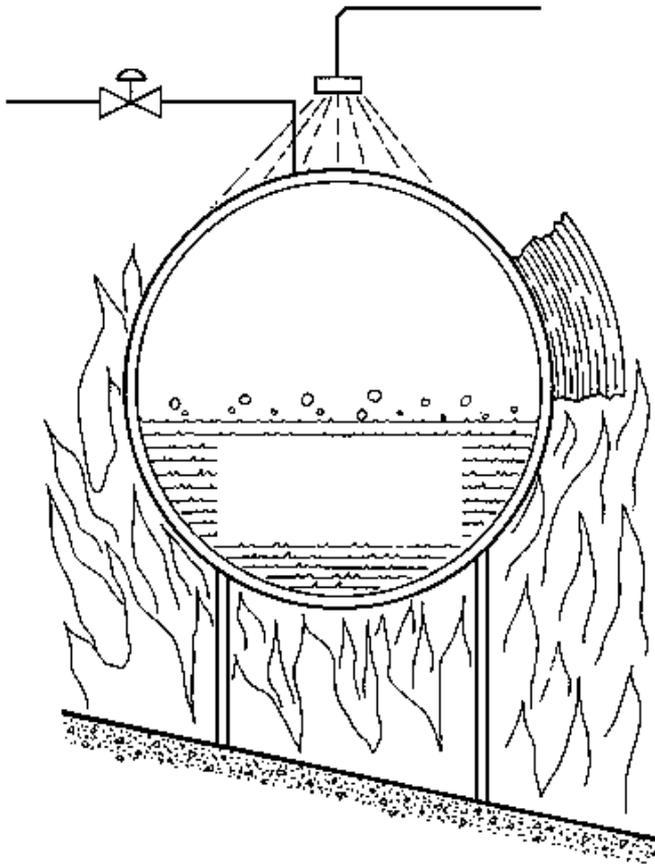


Liquid escapes from vessel, boiling, creating an expanding vapour cloud with huge amounts of energy.

Causes of BLEVE

- The immediate cause of the BLEVE is rupture of the container. If the pressure inside the vessel exceeds the outside strength of the walls the vessel will fail.
- If the vessel is overfilled and expansion (due to boiling of liquid) results in a heavy hydrostatic pressure.
- If the vessel is weakened by mechanical damage or by high temperature resulting from immersion in a fire then failure can occur.

Mechanism of BLEVE



- When BLEVE is initiated, the liquid boils off rapidly producing a reaction which turns parts of the ruptured vessel into rockets which can travel 2500 ft or more.
- The liquid can take fire if it is flammable and burning material can spread over a large area. If the gas or liquid mixes with air a vapour cloud explosion can occur.
- Fragment from one BLEVE can initiate a BLEVE in the nearby second vessel.

BLEVE

- 60% of the expanding energy of LPG is converted to kinetic energy. Maximum initial velocity is observed :
 - Horton Sphere : 200 m/sec
 - Bullet : 150 m/sec
- In case of LPG, distance reached by fragments are as under :
 - Horton Sphere : 600 M
 - Bullet : 1200 M

General Instructions For Drivers

- ▶▶ **Keep the vehicle fit in all respect.**
- ▶▶ **Maintain speed as per prescribed limits.**
- ▶▶ **Do not drive under mental stress conditions.**
- ▶▶ **Park your vehicle in safe place. Do not park near naked flames.**
- ▶▶ **Do not carry flammable material in cabin. Do not light agarbatti / stove in and around truck.**
- ▶▶ **Use prescribed route only.**
- ▶▶ **Be more careful during early morning and evening timings.**
- ▶▶ **Drive carefully on wet, slippery roads and slopes.**

General Instructions For Drivers

- ▶▶ **Be careful while crossing railway crossing.**
- ▶▶ **If vehicle breaks down on road, park it on a safe location and use lights or other visible signals to mark the vehicle.**
- ▶▶ **Do not drive under the influence of liquor.**
- ▶▶ **Be careful of animals and small children on the road Their behavior could be unpredictable.**
- ▶▶ **Use dip lights during night. Keep side blinkers, brakes lights always in working conditions and use them for the benefits of fellow drivers.**
- ▶▶ **No TT will be allowed to enter inside a Bottling Plant / Petroleum Installation without a helper.**
- ▶▶ **Do not use Mobile phone while driving.**