

# **Annual Report on Liquefied Petroleum Gas (LPG) Related Accidents**

**(2015 version)**

The High Pressure Gas Safety Institute of Japan (KHK)

## 1. Introduction

This Annual Report contains accidents that occurred in 2015 related to facilities for supplies and consumptions of LPG at home or on business, which are regulated by the Act on the Securing of Safety and the Optimization of Transaction of Liquefied Petroleum Gas (hereinafter, the “LPG Act”). This report also contains analyses the data of the accidents in 2015 by comparing with those in the last nine years (2006 to 2014).

## 2. Definitions

### 2.1 Definition of accidents

#### (1) LPG accidents

- |                                |  |
|--------------------------------|--|
| [1] Leakage                    | A case in which liquefied petroleum gas (hereinafter, “LPG”) leaked, but it did not catch fire and cause human damages such as poisoning and asphyxiation. However, in this report, leakage of a very little amount of LPG from joints as little as soap bubbles formed when those of threaded parts or rubber tubes are soaked by soap water is excluded.                                       |
| [2] Leakage and explosion      | Cases in which LPG leaked, and it resulted in an explosion or a fire caused by the explosion, as follows.<br>A. Leakage and explosion, when the explosion resulted from leaked gas only.<br>B. Leakage, explosion and fire, when a fire broke out following explosion caused by leaked gas.  |
| [3] Leakage and fire           | A case in which a fire that is not limited to that recognized as a fire by the fire department resulted from leakage of LPG excluding those covered by [2] above. Here, a fire without leakage, which is caused by the overheating or the failure of LPG appliances including their accessories or by spreading of flames from a cooking oven, grill, etc., is not classified as a LPG accident. |
| [4] Poisoning and asphyxiation | A case in which human damages of CO poisoning and asphyxiation are caused due to incomplete combustion, leakage of LPG, or leakage of exhaust gas from exhaust pipes, etc., at LPG consumption facilities.   |

#### (2) Other accidents (not classified as LPG accidents)

[1] Accidents caused by suicide, damage by intention, mischief, theft, or other similar causes

[2] Accidents resulting from a natural disaster

Example) Accidents caused by facilities’ damages resulting from collapse of houses due to earthquake

Example) Accidents caused by facilities’ damages resulting from flood and landslide

Even if accidents are resulted from natural disasters, however, those caused by defects in toppling prevention measures, fallen snow prevention measures (snow shelters, protective boards), or other insufficiencies in safety measures, are classified as LPG accidents.

[3] Accidents involving portable cooking stoves and gas cartridges

[4] Other accidents not categorized in the LPG accidents of (1) above

### 2.2 Classification of human damages

Classified as follows according to the level of damage

Death: when a person was confirmed to have died within about five days from the time of accident

Seriously injured: when a person suffered an injury at the time of accident that took 30 days or more for full recovery

Slightly injured: when a person suffered an injury at the time of accident that took less than 30 days for full recovery

### 3. LPG accidents

#### 3.1 Occurrences of accidents in the past

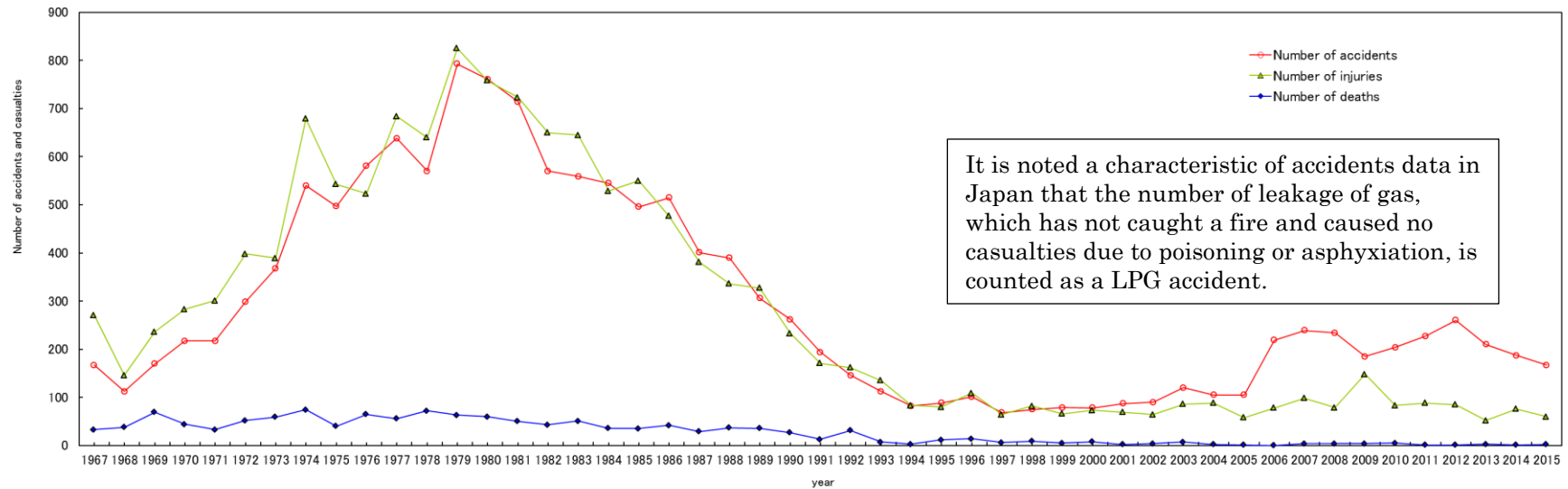


Figure 1: Accident occurrences and casualties by year

Table 1: Change in the number of accidents and casualties by year

Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Number of accidents	167	112	170	217	217	299	368	540	497	581	638	570	793	761	714	570	559	545	496	515	401	390	306	262	194	146	112	82	88	101	68	75	79	78	87	90	120	105	105	219	239
Rate to the previous year	34	▲33	52	28	0	38	23	47	▲8	17	10	▲11	28	▲4	▲6	▲20	▲2	▲3	▲9	4	▲22	▲3	▲22	▲14	▲26	▲25	▲23	▲27	7	15	▲33	10	5	▲2	12	3	33	▲13	0	109	9
Number of deaths	33	38	69	44	33	52	59	74	40	65	56	72	63	60	50	43	51	36	35	42	29	37	36	27	13	31	7	3	12	14	6	9	5	8	2	4	7	2	1	0	4
Number of injuries	271	146	236	283	301	398	389	679	543	523	684	640	825	758	723	650	645	529	550	477	381	336	327	233	171	162	135	83	80	109	64	82	66	73	69	64	86	88	58	78	98

Year	2008	2009	2010	2011	2012	2013	2014	2015
Number of accidents	234	185	204	227	260	210	187	167
Rate to the previous year	▲2	▲21	10	11	15	▲19	▲11	▲11
Number of deaths	4	4	5	1	1	3	1	2
Number of injuries	79	148	83	88	85	52	76	60

Figure 1 shows the number of accidents that occurred between 1967 and 2015 and the resulting casualties. Looking at the data by decade, the number of accidents increased gradually during the 1960s along with the increase in LPG consumption and diversification of users.

In the 1970s, the number of accidents continued increasing along with the number of households using LPG and reached a peak in 1979 with 793 accidents, causing 63 casualties. This was the year that marked the highest number of casualties, at a level similar to that of 1974.

Soon after entering the 1980s, a large-scale city gas explosion took place that resulted in enormous human damages marked by 15 deaths and 222 seriously and slightly injured persons. The number of accidents was 761 that year. The number of accidents peaked out this year and started showing a downward tendency, reducing greatly to 570 in 1982.

Thereafter, the number of accidents continued declining linearly from the late 1980s, falling below 100 in 1994, to 82.

The year 1997 saw the lowest number of accidents (68) since enactment of the LPG Act. In the 2000s, the number of accidents remained above 100 until 2015, although the number of deaths has been on the decrease.

### 3.2 Accident situations by phenomenon

Looking at the accident situations by phenomenon that occurred in 2015, the number of leakage-only accidents that did not start fire or explosion were more than half of total accidents. The number of leakage-only accidents was 87, showing a decrease of 11 from the previous year. The number of leakage and explosion (fire) accidents was 43, showing a decrease of 16 from the previous year. The numbers of accidents by phenomenon in the past decade are shown below.

Table2: Number of accidents by phenomenon

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Leakage	137	113	115	84	76	116	160	113	98	87
Leakage and explosion (Fire)	70	64	53	45	60	55	48	48	59	43
Leakage and fire (Excluding explosion)	6	51	60	42	60	45	44	43	27	31
CO poisoning and asphyxiation	6	11	6	14	8	11	8	6	3	6
Total	219	239	234	185	204	227	260	210	187	167

## 4. Analysis of accident situations

The following kinds of LPG accidents that have occurred frequently were analyzed.

### (1) CO poisoning accidents

As shown in Table 3 and Figure 2, four CO poisoning accidents occurred in 2015, showing an increase of one from the previous year. One of the four was a Class B accident, which represented no increase or decrease from the previous year. The breakdown of four accidents is shown below.

- [1] Accident caused by use of a cast iron cooking range in an unventilated kitchen
- [2] Accident caused by the use of a CF-type tank-less water heater cooking range in an unventilated kitchen
- [3] Accident caused by exhaust failure from cracks in the underfloor flue of sauna equipment
- [4] Accident caused by the use of a gas burner in an unventilated analysis room

Incidentally, the reason why the number of casualties increased to 88 in 2009 was attributed to the large number of casualties per accident in 2009.

Table 3: Number of CO poisoning accidents (excluding asphyxiation) by year and casualties

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of Accidents	5	11	6	14	8	10	8	4	3	4
Of the above, the number of Class B or high class accidents	0	3	2	6	3	3	2	2	1	1
Number of deaths	0	2	2	3	3	1	1	2	1	0
Number of injuries	13	29	8	85	16	32	37	4	4	12
Of the above, the number of Class B or high class accidents	0	9	0	65	7	16	23	1	0	7

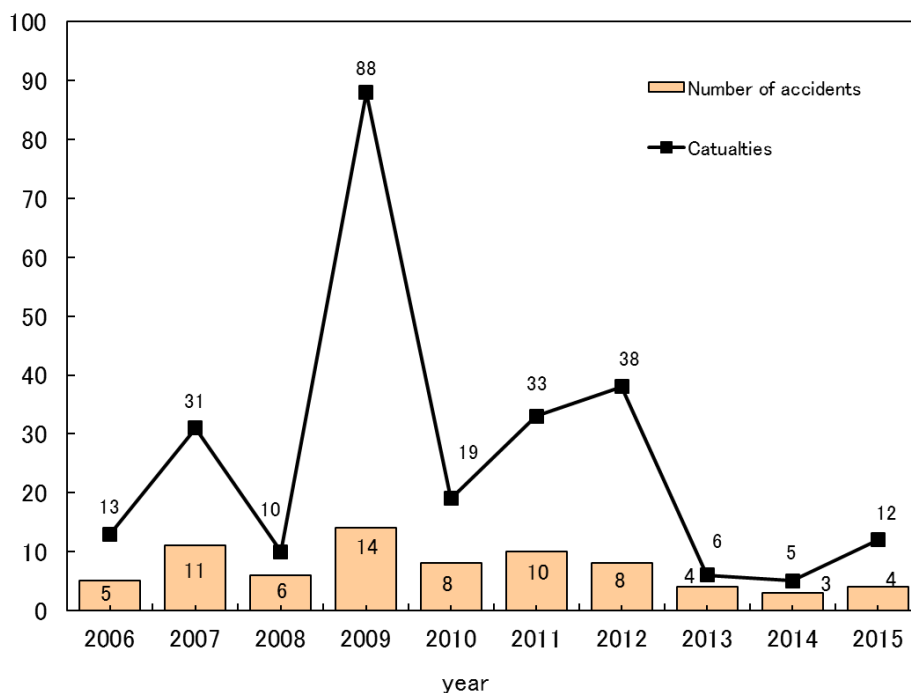


Figure 2: Number of CO poisoning accidents by year and casualties

(2) Buried pipes accidents

The pipes that are installed between LPG cylinders and a gas meter are called supply pipes, and are installed between a gas meter and consumption devices like heaters are called distribution pipes in Japan. Pipes are installed on the ground or underground. The number of supply pipe accidents is greater than distribution pipe accidents.

Table 4 and Figure 3 show that 24 accidents involving buried pipes took place in 2015, a decrease of three from the previous year. 20 out of 24 accidents involved supply pipes, in which one accident were decreased from the previous year, and the other four accidents involved distribution pipes, in which two accidents were decreased from the previous year. Then one accident of Class B occurred.

Causes of accidents include damages in 15 accidents (supply pipes in 15 accidents and distribution pipes in zero accidents) and deterioration due to corrosion in seven accidents (supply pipes in three accidents and distribution pipes in four accidents).

Table 4: Number of buried pipes accidents by year and casualties

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Number of Accidents	17	21	31	24	18	18	16	25	27	24
Of the above, the number of Class B or highr class accidents	1	0	0	0	0	0	0	1	0	1
Number of deaths	0	0	0	0	0	0	0	1	0	1
Number of injuries	3	1	2	0	2	0	0	2	0	1
Of the above, the number of Class B or highr class accidents	2	0	0	0	0	0	0	0	0	0

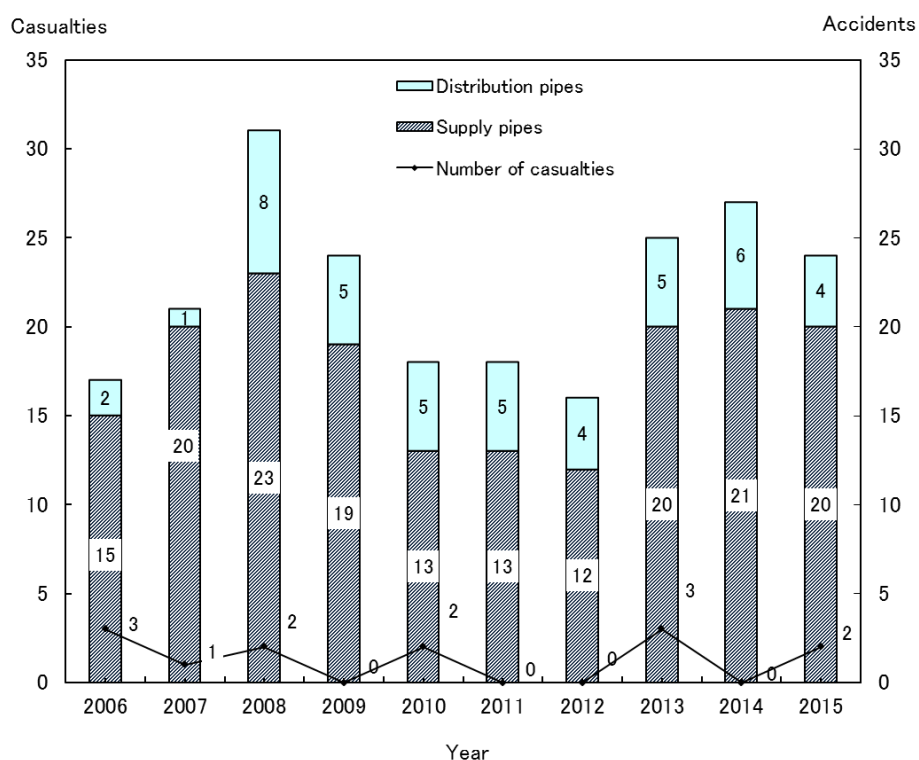


Figure 3: Number of buried pipes accidents by year and casualties

### (3) Bulk supply accidents

In 2015, 4 accidents involving bulk supply (supply facilities only) occurred, showing a decrease of seven from the previous year. The main accidents were as follows.

\*Bulk supply refers to supply of liquefied petroleum gas into bulk storage tanks from portable LPG generators (bulk tank trucks). See Figure 4.

- [1] Gas leakage from liquid outlet valve (two accidents)
- [2] Gas leakage from a regulator caused by liquid movement due to the improper design of the equipment (one accident)
- [3] Gas leakage caused by improper operation during replacement of a bulk storage tank relief valve (one accident)

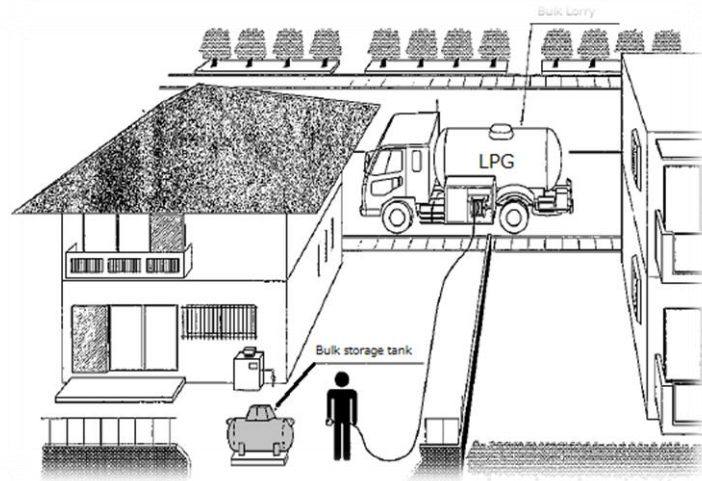


Figure 4: Bulk supply system



Figure 5: Bulk storage tank

## 5. Accident classification

When an accident occurs, it is classified as follows according to the degree of loss.

	Contents of loss	
Class A	(1) Deaths	5 or more
	(2) Deaths plus serious injuries	10 or more
	(3) Casualties (death plus injury)	30 or more
	(4) Direct property damage	200 million yen or more
	(5) Any accident affecting the public, or which could have developed into a large scale disaster	
Class B	(1) Deaths	1 to 4
	(2) Serious injuries	2 to 9
	(3) Casualties (injury)	6 to 29
	(4) Direct property damage	200 million yen or more
	(5) Accidents repeatedly occurring at the same works	
	(6) Any accident affecting the public, or which could have developed into a large scale of disaster.	
Class C	Other than Classes A and B	

<Contact for inquiries related to this document>

## The High Pressure Gas Safety Institute of Japan (KHK)



Information & International Affairs Department

International Affairs Division

4-3-13 Toranomom, Minato-ku, Tokyo 105-8447

TEL: +81-3-3436-2201 FAX: +81-3-3438-4163

Web: <http://www.khk.or.jp/english/index.html>

MAIL: [oversea@khk.or.jp](mailto:oversea@khk.or.jp)