Annual Report on High Pressure Gas Related Accidents

(2012 version)

The High Pressure Gas Safety Institute of Japan

1. Introduction

This Annual Report analyzes and evaluates accidents relating to the High Pressure Gas Safety Act that occurred from January to December 2012, with an aim of contributing toward future high pressure gas safety measures.

Note that among high pressure gas-related accidents, this Annual Report excludes those involving general consumers, which pertains to the Act on the Securing of Safety and the Optimization of Transaction of Liquefied Petroleum Gas. .

2. Accidents relating to the High Pressure Gas Safety Act

The number of accidents relating to the High Pressure Gas Safety Act per year remained around 100 until 1999. Subsequently, it has increased since 2000 and has remained at a high level in recent years. However, fewer accidents occurred in 2012 than in the previous year, which is the first time since 2000.

One of the causes of the increase in number of accidents in recent years is the increase in number of theft and loss of containers (hereinafter, “theft and other accidents”). However, it is difficult to discuss loss and theft accidents by statistically treating them along with explosion, leakage, and other ordinary disasters (hereinafter, “ordinary accidents”), because of characteristic differences. Thus, this Annual Report summarizes and analyzes the high pressure gas-related accidents by separating the loss and theft from the ordinary accidents. Also, the accident countermeasures manuals were revised in 2011, resulting in significant changes in the definitions of accidents and items of accident causes. Thus, the analysis and evaluation on accident causes and others below were conducted separately for the years 2011 and 2012 fromthose up to 2010.

2.1 Changes in number of accidents and analysis/evaluation

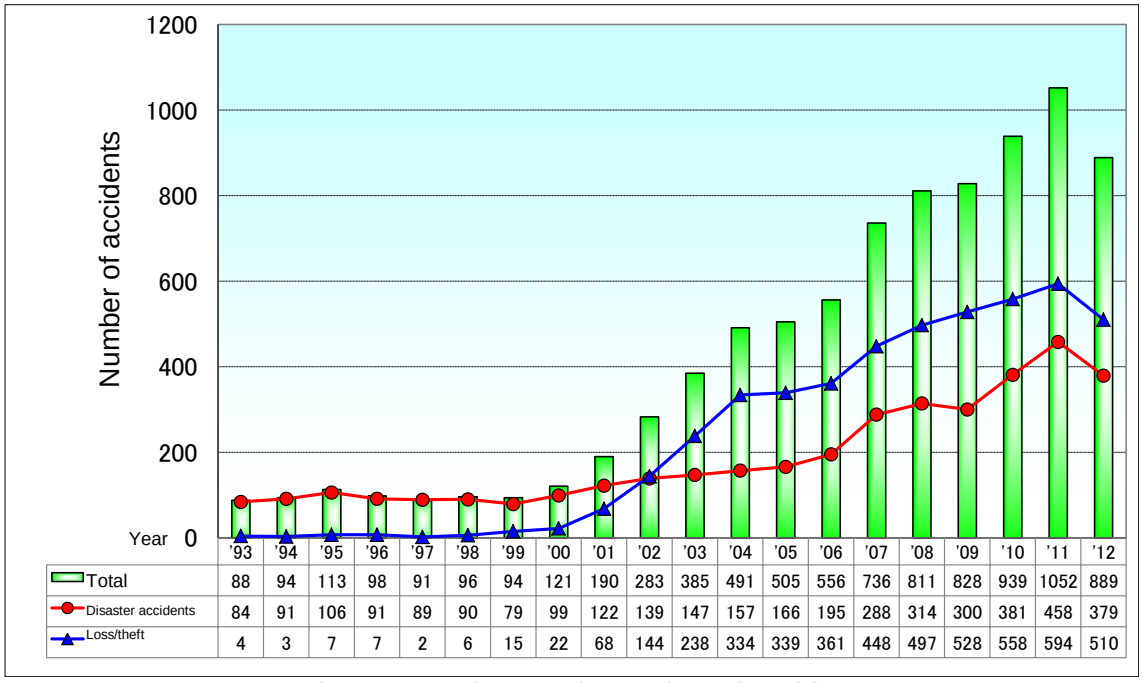
(1) Change in number of accidents by year

Figure 1 shows the number of accidents that occurred in the latest decade (2003 to 2012).

In the last five years, the number of accidents occurring in 2008 was 811, and thereafter 828 in 2009, 939 in 2010, 1052 in 2011, and 889 in 2012, showing decrease from 2011. However, the number of accidents still remains high

Here, the increase in the number of accidents in 2011 is mainly due to the report of 94 accidents that caused by the Great East Japan Earthquake.

Also to note is that although almost no reports have been made on theft and other accidents in past years, the number has continued increasing rapidly since 2000, as a result of guidance to promote reports on such accidents.



Year	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Total	88	94	113	98	91	96	94	121	190	283	385	491	505	556	736	811	828	939	1052	889
Disaster accidents	84	91	106	91	89	90	79	99	122	139	147	157	166	195	288	314	300	381	458	379
Loss/theft	4	3	7	7	2	6	15	22	68	144	238	334	339	361	448	497	528	558	594	510

Figure 1 Changes in number of accidents

(2) Numbers of accidents by category

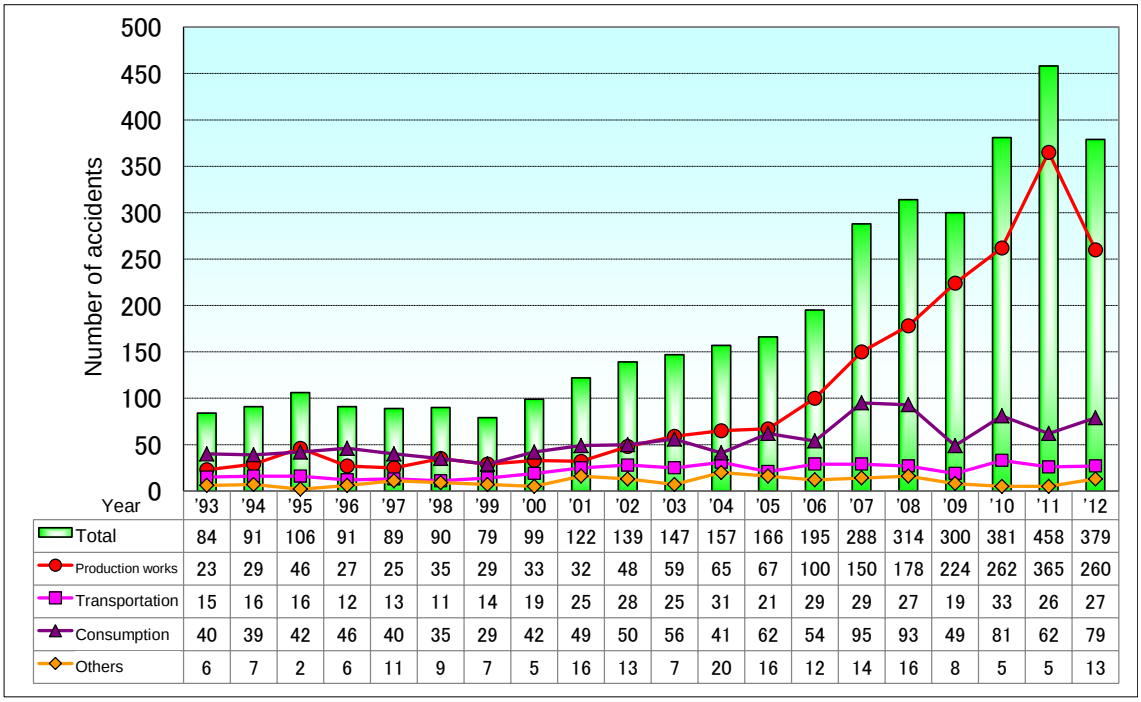
From this section onwards, the focal point of discussion is placed on disaster accidents.

Figure 2 shows the results of statistic treatment of the disaster accidents that occurred in the last two decades (1993 to 2012), according to accident categories.

A notable feature is that the number of accidents has been on the increase since 2000.

The breakdown of the 379 disaster accidents that occurred in 2012 shows, in decreasing order, 260 disaster accidents occurring at production works (69%), 79 during consumption (21%), 27 during transportation (7%), and 13 others (3%).

As can be seen, the majority of disaster accidents have taken place at production works, and the ratios of accidents in 2012 are fairly similar compared to those during the lastfive years. Thus, it is clear that accident occurrences at production works have remained at a high level.



Year	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Total	84	91	106	91	89	90	79	99	122	139	147	157	166	195	288	314	300	381	458	379
Production works	23	29	46	27	25	35	29	33	32	48	59	65	67	100	150	178	224	262	365	260
Transportation	15	16	16	12	13	11	14	19	25	28	25	31	21	29	29	27	19	33	26	27
Consumption	40	39	42	46	40	35	29	42	49	50	56	41	62	54	95	93	49	81	62	79
Others	6	7	2	6	11	9	7	5	16	13	7	20	16	12	14	16	8	5	5	13

Figure 2 Changes in number of accidents by accident category

(3) Analysis and evaluation based on accident causes

Figure 3 shows the results of the disaster accident statistics by causes which occurred during the 18 years between 1993 and 2010, and Figure 4 shows the one which occurred in 2011 and 2012. .

Looking at the 379 disaster accidents in 2012, 170 (45%) were caused by inadequate facility maintenance and management, 72 (19%) were caused by human factors, and 41 (11%) were caused by inadequate facility design and defects in fabrication, together accounting for 75% of the total.

The ratios of first two factors among overall accident factors are significantly large, emphasizing the importance of facility maintenance and management, as well as human error prevention measures such as education and training.

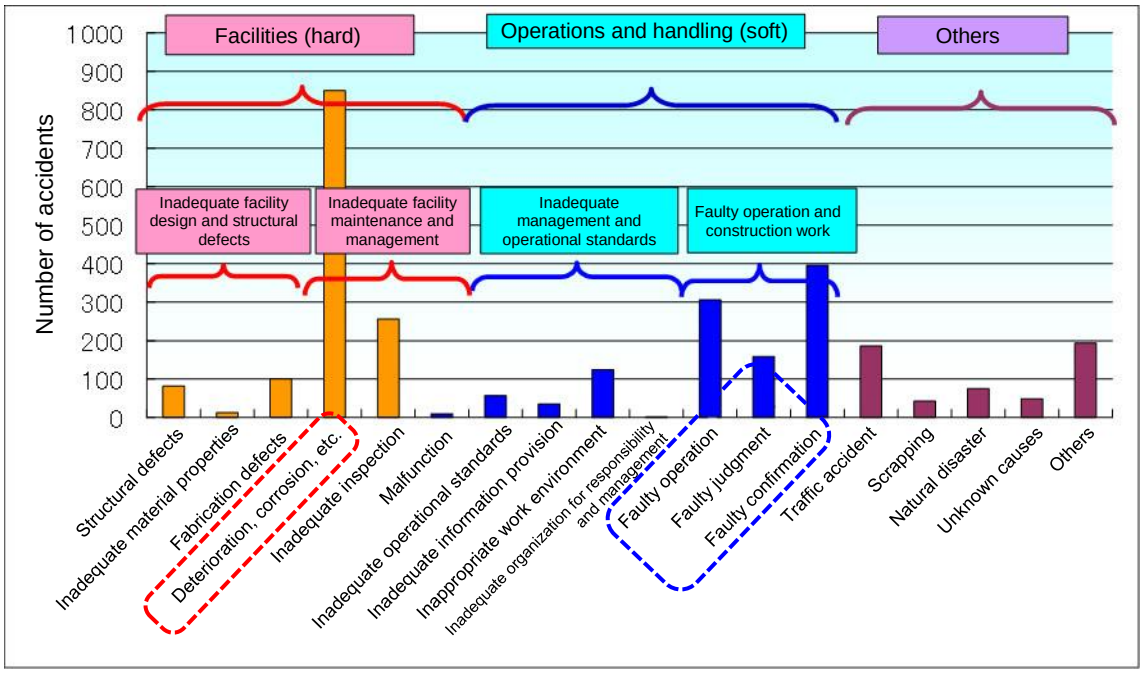


Figure 3 Analysis and evaluation based on accident causes (1993 to 2010)

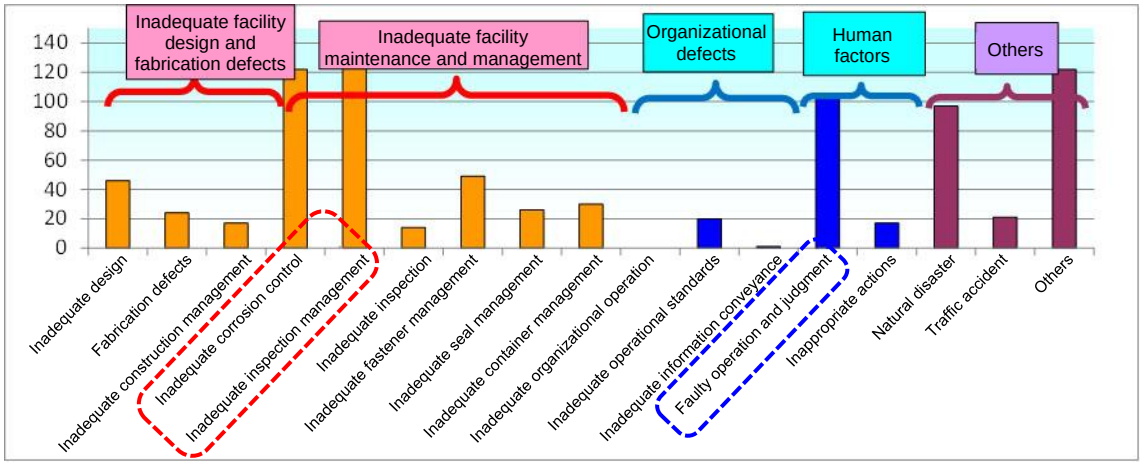


Figure 4 Analysis and evaluation based on accident causes (2011, 2012)

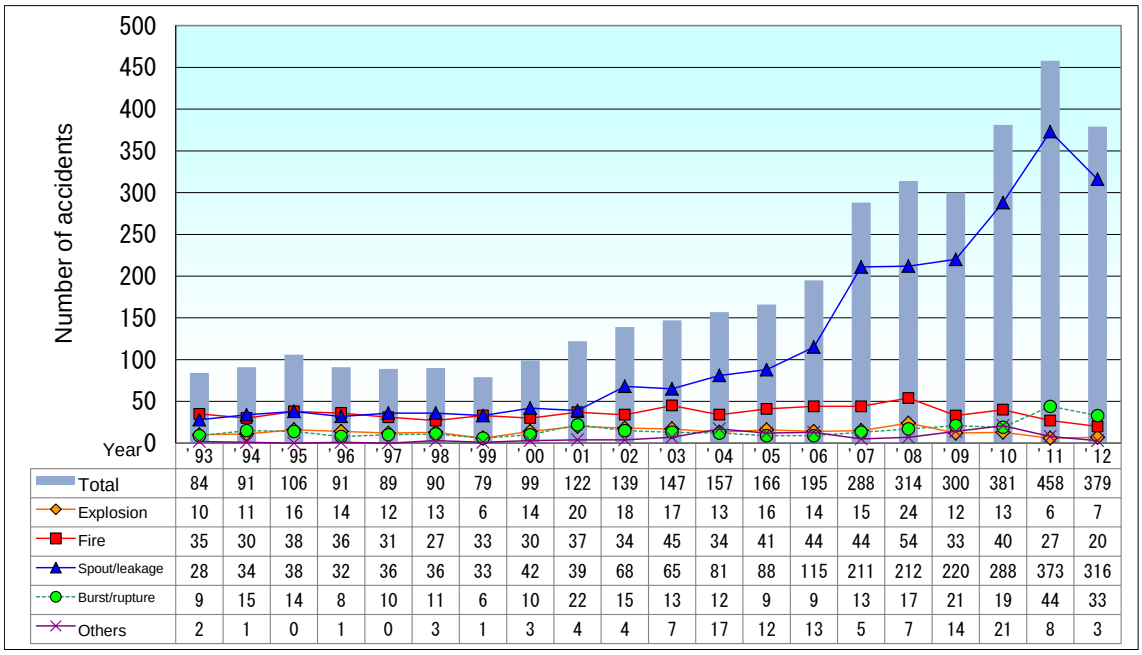
2.2 Analysis based on phenomenal categories, human damages, and accident classifications

(1) Analysis based on phenomenal categories

Figure 5 shows the statistical results of the disaster accidents that occurred during the last two decades (1993 to 2012), classified by phenomenon categories.

The total number of accidents in 2012 was 379, and looking at accident phenomena, spout/leakage accounted for 316 accidents (83%), burst/rupture for 33 accidents (9%), fire for 20 accidents (5%) and explosion for 7 accidents (2%), in that order. The majority of these accidents were spout/leakage.

During the last five years, spout/leakage accounted for 1,409 accidents (77%), fire for 174 accidents (9%), burst/rupture for 134 accidents (7%), and explosion for 62 accidents (3%), in that order.



Year	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Total	84	91	106	91	89	90	79	99	122	139	147	157	166	195	288	314	300	381	458	379
Explosion	10	11	16	14	12	13	6	14	20	18	17	13	16	14	15	24	12	13	6	7
Fire	35	30	38	36	31	27	33	30	37	34	45	34	41	44	44	54	33	40	27	20
Spout/leakage	28	34	38	32	36	36	33	42	39	68	65	81	88	115	211	212	220	288	373	316
Burst/rupture	9	15	14	8	10	11	6	10	22	15	13	12	9	9	13	17	21	19	44	33
Others	2	1	0	1	0	3	1	3	4	4	7	17	12	13	5	7	14	21	8	3

Figure 5 Change in number of accidents by phenomenon category

(2) Analysis based on human damages

Figure 6 shows the statistical results of the disaster accidents that occurred during the last two decades (1993 to 2012), classified by human damages.

The number of accidents resulting in injury or death was 41 in 2012, accounting for 11% of the 379 disaster accidents. The number of persons suffering injury or death was 67, making the number of casualties per physical injury accident 1.63.

The results of the same calculation for the 1,832 disaster accidents, 207 physical injury accidents, and 423 casualties in the last five years indicate a ratio of physical injury accident of 11% and a number of casualties per physical injury accident of 2.04.

The number of physical injury accidents was 41 in 2012, which was greater than the 33 that occurred in 2011. On the other hand, the number of casualties reduced from 71 in 2011 to 67 in 2012.

An accident that resulted in the greatest number of casualties in 2012 was an explosion at a resorcinol production facility that injured 10 persons.

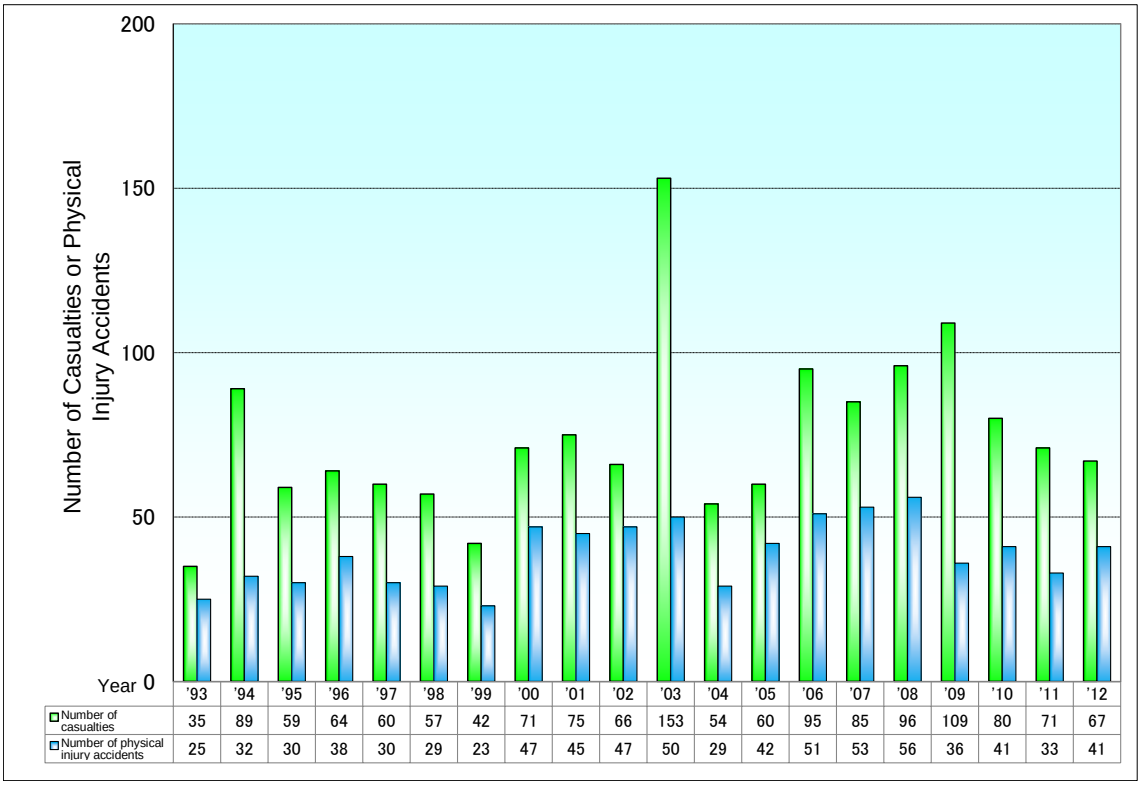


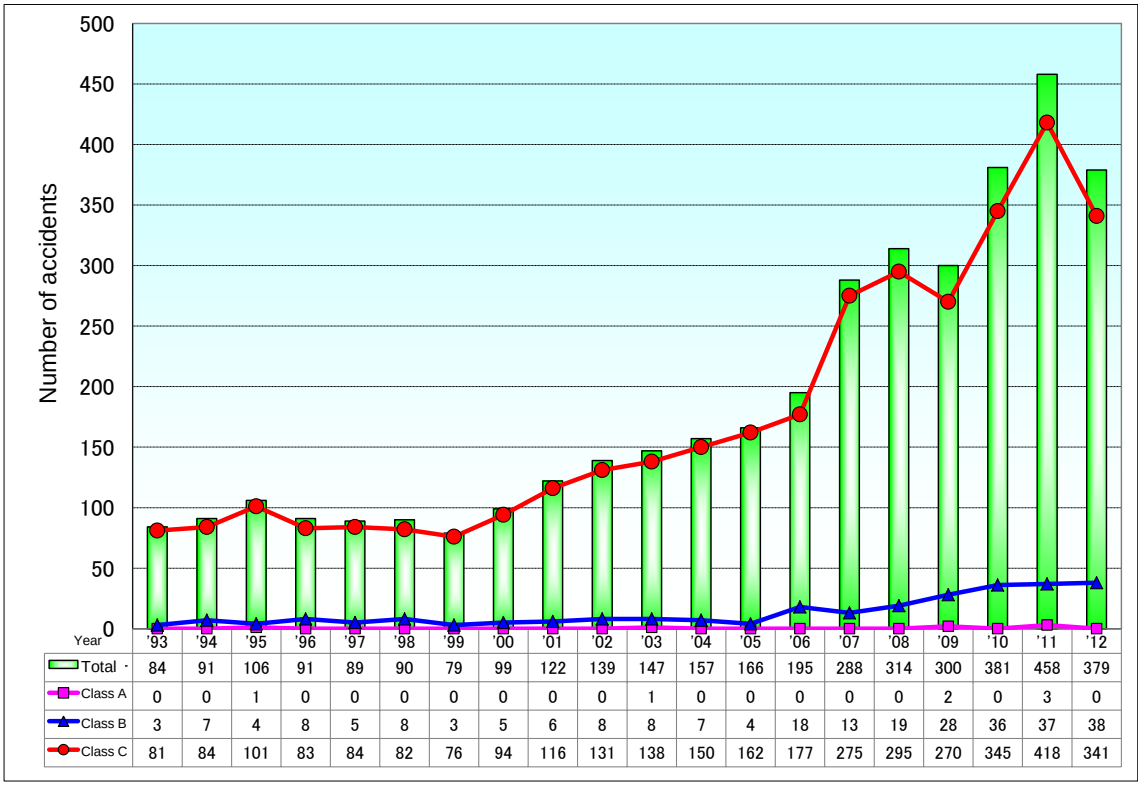
Figure 6 Change in number of physical injury accidents and casualties

(3) Analysis based on accident classifications

Figure 7 shows the statistical results of accidents that occurred during the last two decades (1993 to 2012), classified by accident classifications.

Although three Class A accidents occurred in 2011, none took place in 2012.

About 10 Class B accidents took place each year until 2005, which increased greatly to 25 in 2006 and to 41 in 2010, but reduced to 37 in 2011 and remained at the same level at 38 in 2012. The reasons why the 38 accidents in 2012 were classified as Class B accidents include 33 cases where two or more accidents occurred repeatedly at the same facilities during the year, one case where the number of injured persons was six or more and up to 29, one case where the number of seriously injured persons was two more and up to nine, and three cases where the number of deaths was one or more and up to four.



Year	'93	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Total	84	91	106	91	89	90	79	99	122	139	147	157	166	195	288	314	300	381	458	379
Class A	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	3	0
Class B	3	7	4	8	5	8	3	5	6	8	8	7	4	18	13	19	28	36	37	38
Class C	81	84	101	83	84	82	76	94	116	131	138	150	162	177	275	295	270	345	418	341

Figure 7 Changes in number of accidents by accident classification

Table 8 Definition of classification by degree of loss

	Contents of loss
Class A	(1) Deaths 5 or more (2) Deaths plus serious injury 10 or more (3) Victims (death plus injury) 30 or more (4) Direct property damage 500 million yen or more or, (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 injury 2 to 9 (3) Victims (injury) 6 to 29 (4) Direct property damage 100 to 500 million yen (5) Accidents repeatedly occurring at the same works or, (6) Any accident affecting the public, or which could have developed into a large scale of disaster.
Class C	Others

2.3 Accidents related to the High Pressure Gas Safety Act that occurred in 2012

Accident title	Explosion and fire of resorcinol production facility	Explosion during demolition of CNG container for automotive fuel	Burst of engine crank case during pneumatic test
Date	April 22	September 4	November 15
Deaths/ serious injuries/ minor injuries	1/2/7	1/1/0	1/0/2
Overall toll	10	2	3
Substance name	Propylene	Natural gas	Nitrogen
Class	B	B	B
Primary phenomenon/ secondary phenomenon	Explosion/ fire	Explosion/ -	Container damage, etc./ -
Situations of handling	During production (Emergency shutdown)	Other (scrapping)	Other (during airtightness test)
Accident causes (main causes)/ (secondary causes)	Other (under investigation)/ -	Faulty operation, faulty judgment/ inadequate information conveyance	Other (under investigation)/ -
Ignition source	Under investigation	Electric rotary saw	None
Accident outline	At 23:30 on April 21, plants supplied with steam (70% of all plants) came to an emergency shutdown due to emergency shutdown of the steam supply system. At 02:15 on the 22nd, the resorcinol production facility that had halted in emergency exploded and a fire broke out, and the fire spread to burn down the adjacent cymene plant and utility piping rack. The situation was brought under control at 17:15 on the 22nd, and the fire was extinguished at 14:31 on the 23rd. The causes are being investigated. Here, the resorcinol production facility used propylene with five heat exchangers, as high pressure gas equipment.	Natural gas (of unknown residual pressure) remaining in a CNG container for automotive fuels, which had been damaged by the tsunami at the time of the Great East Japan Earthquake, caught fire and exploded while being cut and demolished by an electric rotary saw (commonly known as a baby sander), at the sites. Although the ignition source is unknown, sparks from the rotary saw are believed to be the source, because no fire was used in the surroundings. The company is a container reinspection station for LP gas and fluorocarbon. It had accepted one CNG container (made of FRP) that an automotive dismantler was having difficulty handling, and stored it on the company's premises, without giving serious thought. The accident is believed to have taken place because of inadequate information conveyance, which caused workers to start demolition work without much information.	An airtightness test (of the specified pressure of 5MPa) was started at the works, intended to test leakage from the product (crank case for a Stirling engine). The airtightness test was conducted using one 7m3 container of compressed nitrogen, regulators, high pressure rubber hose, etc. A leakage test using soapy water was conducted when the pressure reached about 3MPa, which confirmed there was no leakage. Then, an attempt was made to raise the pressure to the specified value of 5MPa, but the pressure rose only to about 4MPa, because gas in the container ran out. The container was replaced and pressure raising work resumed, and the product burst when the pressure rose close to about 5MPa. The burst of the product resulted in the death of one worker and an injury to another worker, who were engaged in the work. Another worker who was passing by was also injured. The cause of the accident is being investigated.

＜Contact for inquiries related to this document＞

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