

# Fire and Explosions at Chiba Refinery

Updates on the March 11 accident at the Chiba Refinery have been posted to the Cosmo Oil website.

## Accident Summary

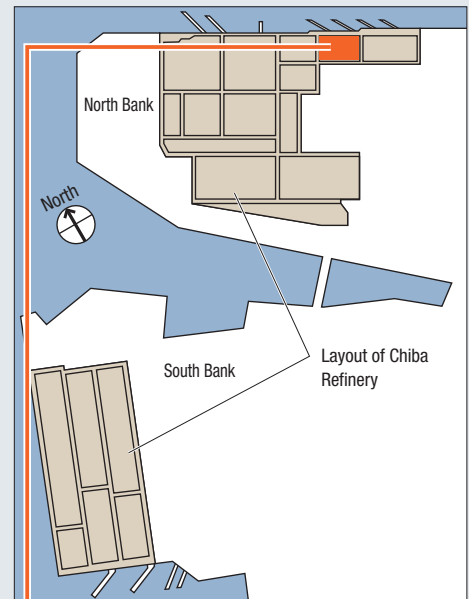
On March 11, 2011, the Great East Japan Earthquake occurred off the coast of Tohoku, followed by a subsequent quake off the coast of Ibaraki Prefecture. The quakes triggered a fire and explosions at the liquefied petroleum gas (LPG) facilities of the Cosmo Oil Chiba Refinery in Ichihara City, Chiba Prefecture. The fire was successfully extinguished on March 21, but the Chiba Refinery remained shut down as of September 30, 2011. Production at the Yokkaichi Refinery and Sakaide Refinery has been increased since March 15.

In response to the accident, Cosmo Oil assembled the Accident Investigation Committee on April 1, 2011, which has produced a report on its findings. The report details the circumstances and causes of the accident as well as measures to prevent future accidents.

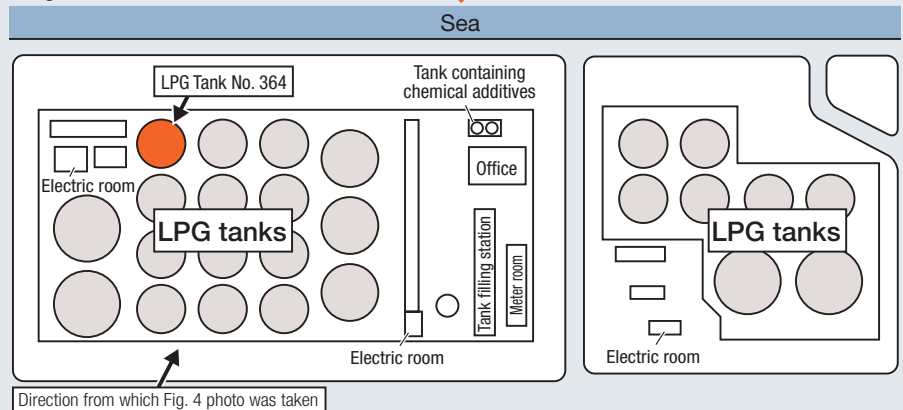
The facts surrounding the fire and explosion are as follows, in chronological order:

- ◎ At 2:46 p.m. on March 11, 2011, the Great East Japan Earthquake occurred in the Pacific Ocean off the coast of Tohoku. The quake registered a lower-five in seismic intensity (Japan's measure of earthquake intensity in terms of "degree of shaking") in Ichihara City, Chiba Prefecture, some distance away from the epicenter.
- ◎ The quake caused the fracture of many cross-braces on the support legs of LPG Tank No. 364 (Fig. 2 and 3), which at the time was not full of LPG, but water used to purge air from the tank for a regulatory overhaul inspection.
- ◎ At 3:15 p.m., another earthquake occurred off the coast of Ibaraki Prefecture. The quake registered a four in seismic intensity in Ichihara City.
- ◎ The second quake buckled the support legs (with fractured cross-braces) of LPG Tank No. 364, which caused the tank to collapse. This led to the rupture of multiple pipes near the tank, and the leakage of LPG.
- ◎ The leaking LPG spread and caught fire, leading to a fire near LPG Tank No. 364 (Fig. 4).
- ◎ The fire caused an adjacent LPG tank to explode, as the fire spread.
- ◎ The spreading fire caused the explosion of other nearby LPG tanks, and the fire continued to spread.
- ◎ After continuous efforts to put out the fire, it was completely extinguished at 10:10 a.m. on March 21, 2011.

■ Figure 1. Chiba Refinery site



■ Figure 2. LPG tank site



## Injury and Damage Report

### Injuries

- Six persons were injured, including five minor injuries and one serious injury.

### Physical Damage

- All 17 LPG tanks on the site of the fire were damaged. Nearby pipelines and roads were also damaged.
- There was damage to adjacent asphalt tanks and leakage of asphalt. (Asphalt recovery was completed on May 10, 2011.)
- The shockwaves and debris from the explosions triggered fires on adjacent premises operated by Maruzen Petrochemical Co., Ltd. and Chisso

Petrochemical Corporation. There was also damage to nearby vehicles and ships as well as building windows.

- The shockwaves from the explosions broke windows and damaged shutters and roof shingles in nearby residential areas. Lightweight insulation debris also soiled vehicles in residential areas.

### Environmental Damage

- The fire caused the combustion of all 5,227 tonnes of LPG stored on the site. All of the leaked asphalt was successfully recovered. As a result, no lasting impact on air, water or soil from the accident has been observed.

## Actions of the Accident Investigation Committee

Cosmo Oil formed the Accident Investigation Committee on April 1, 2011, which included outside experts. The actions of the committee and its sub-committees are outlined below.

April 1, 2011	Visit to accident site by Committee	May 30, 2011	Second meeting of the Committee
April 11, 2011	First meeting of the Committee	June 16, 2011	Second meeting of sub-committees on earthquake resistance and fire
April 25, 2011	First meeting of the sub-committee on earthquake resistance	July 4, 2011	Third meeting of the Committee
April 26, 2011	First meeting of the sub-committee on fire	July 28, 2011	Fourth meeting of the Committee
May 18, 2011	On-site investigation by the Committee		

## Accident Causes and Future Preventative Measures

### 1. Fracture of Many LPG Tank Support Cross-braces, and Buckling and Collapse of Tank Supports

LPG Tank No. 364 was designed and built to seismic standards. At the time of the accident, the tank was full of water, which weighs twice as much as LPG, in preparation for regulatory overhaul inspections. The initial quake, combined with the added weight, caused the support cross-braces to fracture, and the subsequent quake caused the support legs to buckle and the tank to collapse. Better recognition was needed of the potential risk from an earthquake occurring when a tank was filled with water.

From now on, the Company will shorten the period during which the tanks are filled to capacity with water. Future LPG tanks will be designed specifically to hold a full tank of water, and existing LPG tanks will be evaluated and reinforced. To address the possibility of a tank collapsing, thereby damaging nearby pipelines and equipment, the Company will modify its facilities to protect pipelines and equipment, and enable the isolation and separation of pipelines as safeguards against LPG leakage.

### 2. LPG Leaks

The evidence indicates that the quakes shook but did not damage the actual LPG tanks and pipelines. The collapse of LPG Tank No. 364 is what fractured pipelines and caused the leakage of LPG.

The evidence further suggests that LPG was leaking from three places, one of which was connected to an emergency shutoff valve<sup>1</sup> that had been locked in an open position. This had been done prior to the quake in order to repair a minor leak in a pipeline that supplies air to open and close the valve. For the repair, the emergency shutoff valve was locked open to prevent it from closing when the air pressure dropped during the work.

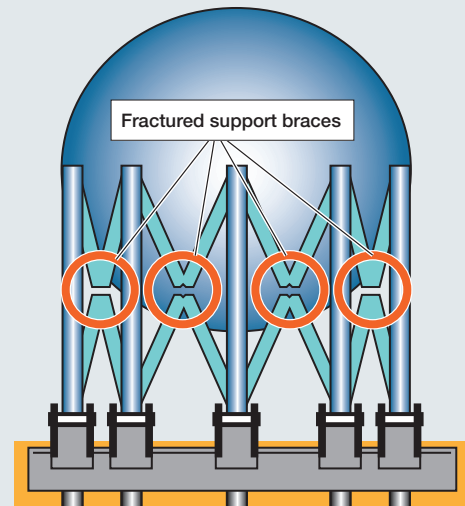
The emergency protocol calls for workers to manually release the emergency shutoff valve from the open position in an emergency. However, workers were unable to get near the valve during the March 11 accident, due to the leaking LPG.

As a preventive measure, LPG tanks will be surrounded by flexible pipelines<sup>2</sup> to prevent damage should a tank collapse on the pipelines. In addition, Cosmo Oil has eliminated the practice of locking emergency shutoff valves in an open position.

### 3. Cause of Ignition, Resulting Explosion and Spread of Fire

The investigation was unable to determine the exact cause of ignition. After the fire broke out, fire crews continuously sprayed water on the surrounding LPG tanks to keep them cool, but the fire near LPG Tank No. 364 grew in intensity, which raised the surface temperature of the adjacent LPG tanks. This weakened the tanks, to the extent that they could not contain their internal pressure, and the resulting explosions caused the fire to spread.

■ Figure 3. Fractured support braces of LPG Tank No. 364



■ Figure 4. Ignition of leaking LPG and fire

Refer to Fig. 2 for the location of the fire in relation to the site.



1. An emergency shutoff valve is a safety device that is designed to safely and immediately shut off if there is an LPG leak.
2. The use of flexible piping enables pipelines to better absorb impacts and bend under pressure.

# Initiatives to Enhance Safety

## Safety Management System

Cosmo Oil's safety management system has focused on the response to safety incidents and preventative measures to address issues that arose from past incidents. The Company also has strongly emphasized regulatory compliance in the filing of construction approvals, and for equipment standards and government reporting. However, in analyzing the March 11 accident at the Chiba Refinery, the Company is aware that there are ways in which it could have been better prepared for an emergency such as a quake. The Company also recognizes the need for better awareness of regulations and potential risks associated with the decisions to lock the emergency shutoff valve in an open position and to store water in LPG tanks during the overhaul. In order to address these issues, the Company will take the actions outlined below.

### 1. Implementation of Comprehensive Safety Inspections

The Company will ensure that all employees of the Refinery—including management under the leadership of the refinery general manager—are completely aware of rules under Japanese accident prevention laws on high pressure gases, fire service, and petroleum complexes. All personnel will be reminded of their roles, responsibilities and jurisdiction, which they will make certain to execute.

Refinery workers will use safety equipment checklists to check their own and each other's work, which will reinforce the understanding of regulatory and in-house safety standards, and allow a correct grasp of potential risks. Managers will also be asked to work in unison with refinery workers and verify checklists in person.

### 2. Improvement of Contingency Response

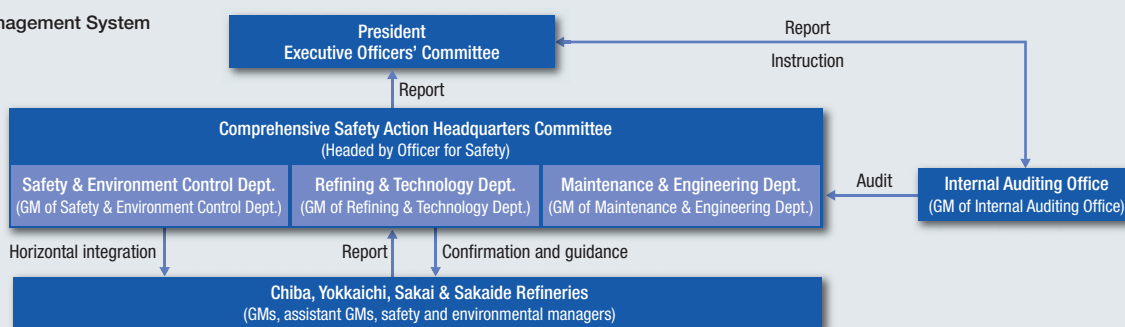
In addition to initiatives that are already being implemented by Cosmo Oil and the Chiba Refinery, the Company will continue to conduct refinery-wide drills in preparation for a large-scale disaster, while improving employee awareness of the contingency response. In conducting these drills, the Company will reexamine the level of collaboration between departments and improve manuals to enhance effectiveness of drills. The Company will also work harder on hazard prediction activities and improve risk estimation, while ensuring skills are passed on to less experienced workers at refineries.

### 3. Management of Preventative Measures and Implementation at Other Refineries

The Chiba Refinery will monitor the progress of the above activities, and the Head Office and other Group refineries will audit the activities to ensure that they are being executed properly. The supervising department at the Head Office will verify security, maintenance and operational management. The Internal Auditing Office, which reports directly to the President, will audit the details of this verification and report to management on the level of effectiveness. If there are any deficiencies in the level of effectiveness, the Chiba Refinery will implement improvements and take action to address the deficiencies. The Company will conduct regular internal audits in order to verify the progress of the preventative measures.

Areas for improvement that are identified during the implementation of preventative measures will also be addressed at other Group refineries, to enhance safety effectively throughout the Group.

#### ■ Safety Management System



## Supply Situation Since March 11 Quake

The March 11 quake caused the shutdown of the Chiba Refinery and of refineries and shipping terminals in and around the Tohoku region, leading to shortages in the supply of petroleum products. In order to make up for the shortages, on March 15 the Company increased the daily crude oil processing capacity at the Yokkaichi Refinery and Sakaide Refinery by 50,000 barrels and 30,000 barrels, respectively. The additional 80,000 barrels per day brought output back to more than 70% of the regular level. The Company also took steps to secure supply for the Japanese market by importing petroleum products and temporarily freezing exports.

#### ■ Refinery Capacity

Refinery	Crude Oil Processing Capacity		Barrels per Day
	Before	Now	Change
Chiba Refinery	220,000	220,000 <sup>1</sup>	±0
Yokkaichi Refinery	125,000	175,000	50,000
Sakai Refinery	100,000	100,000	±0
Sakaide Refinery	110,000	140,000	30,000

1. Output at zero due to shutdown.

# Securing a Continuous Supply of Petroleum for Daily Life and Social Activity

## Response to March 11 Quake and Future Measures

Cosmo Oil has a business continuity plan (BCP) to secure the continuity of business execution during a large-scale disaster. The BCP outlines the Company's basic policies as well as the framework and guidelines for securing business continuity. After the March 11 quake, the Company's business locations began working together in accordance with the basic policies of the BCP, to continue executing priority tasks based on the available refining and delivery capacity. Every effort was made to reopen quickly the supply chains that were interrupted by the quake.

### Basic Policies of Business Continuity Plan

- ◎ Take action with top priority on saving lives.
- ◎ Once the safety of employees and their families is secured, work to secure best possible, stable product supply.
- ◎ Take steps to prevent secondary disasters, and assist recovery and reconstruction efforts in disaster zones.

### Actions Taken and Future Measures

The following paragraphs summarize the main actions taken by the Company to support the early recovery of areas affected by the March 11 quake. These actions were based on a Company-wide consensus to prioritize the supply of petroleum products that are essential to social activity, and quickly restart the refinery and shipping terminals that were shut down due to the quake. The Company will identify shortcomings and issues in its response to the March 11 quake, and take appropriate steps to address them.

#### 1. Verification of Safety

The Company placed the highest priority on verifying the safety of employees, their families, and dealers.

#### 2. Supply of Emergency Fuels

In order to save as many lives as possible, the Company made it a priority to supply fuel to Japan Self-Defense Forces and hospitals, as well as fuel for the transport of emergency supplies.

#### 3. Cooperation with Emergency Measures by Japanese Government

- ◎ Increased Production of Petroleum Products  
In order to make up for the loss of supply from the Chiba Refinery, the Company increased production at the Yokkaichi,

Sakai and Sakaide refineries located in western Japan. These products were shipped to disaster zones.

- ◎ Designation of Priority Service Stations for Petroleum Supply  
Cosmo Oil designated 84 service stations as priority supply points to secure the continuing supply of petroleum products for emergency vehicles and transport vehicles for relief supplies. The Company coordinated with emergency disaster response offices set up by local government authorities, to deliver petroleum products to these service stations. The Company also shipped kerosene and light oil in drums at the request of the Japanese government.

#### 4. Continued Operation of Service Stations and Reopening of Service Stations

- ◎ Support for Dealers  
In addition to securing the supply of petroleum products to dealers, the Company provided other kinds of assistance including extended payment terms.
- ◎ Support to Reopen Service Stations  
The Company supported service stations capable of being quickly reopened, by supplying secondhand fuel pumps and providing other assistance.

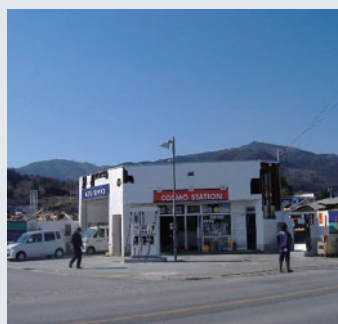
#### 5. Customer Support and Assistance

- ◎ Customer Inquiries  
The Company increased staffing at its customer center,<sup>1</sup> in order to field inquiries on topics like the location of open service stations. (For more information, see page 33.)
- ◎ Cosmo The Card  
The Company offered Cosmo The Card users the option of donating their Cosmo Gasoline Mileage rebates to the Japanese Red Cross Society for disaster relief. (For more information, see page 23.)
- ◎ Cosmo B-cle Lease  
The Company utilized the Cosmo B-cle Lease network to provide vehicles and fuel at no charge for local government use, and provide discounted vehicle leasing rates and fuel cash back benefits for individuals. (For more information, see page 23.)

1. The customer center fielded some 4,300 inquiries in March 2011 including questions that were connected with the disaster. This was 12 times the volume of inquiries fielded in the same month last year.



Service station damaged due to March 11 quake (taken on March 25, 2011)



Service station after reopening for business (taken on April 5, 2011)

The Company's relevant business locations have been working together to implement the above measures since the March 11 quake, striving to restore product supply to normal levels. The Company has also launched a comprehensive examination of its response to the disaster to identify issues with the response, implement improvements including changes to the BCP manual, and share these improvements with the relevant business locations. The goal is to learn as much as possible in order to be better prepared for future unforeseen circumstances. The Company continues to work with its business locations to build a stronger product supply framework, including redefining basic aspects of the Company's disaster response and developing detailed business operation procedure manuals.