

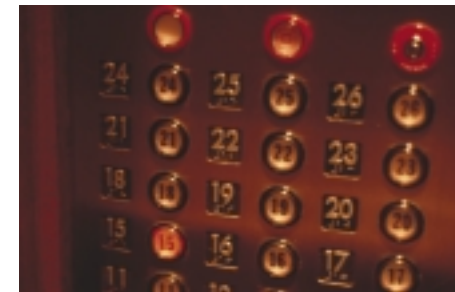
CALENDAR YEAR

2002 STATE OF PUBLIC SAFETY



TECHNICAL STANDARDS
& SAFETY AUTHORITY

BOILER & PRESSURE VESSELS



ELEVATING & AMUSEMENT DEVICES FUELS SAFETY



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DEFINITIONS

Amusement Device – A mechanical device or structure used to entertain members of the public by moving them or causing them to be moved. Typical examples include roller coasters, Ferris wheels, merry-go-rounds, go-karts, water slides and bungee-type rides and devices.

Boilers and Pressure Vessels – Equipment used to produce and distribute hot water, steam, compressed air, and a variety of compressed liquids and gases for industrial purposes.

Bungee Ride or Bungee Type Device – An amusement device that uses elastic rope or metal rope and springs (or any other means) to create bouncing action for the purpose of dropping a person from a height, propelling a person in a horizontal or vertical direction, or combination thereof.

Certification – An authorization issued to a person or persons for successfully completing a program approved by a director to carry out an activity referred in the regulations or a Minister's order. The program shall be conducted by an accredited training organization approved by a director and registered with the designated administrative authority.

Children – Persons who are aged 12 years or younger.

CO – Carbon Monoxide

Diesel Fuel – Fuel composed of hydrocarbons that are heavier (i.e., they have a higher boiling point) than the components found in gasoline.

Elevator – A lifting device, equipped with a carrier that moves vertically in guides, that serves two or more floors of a building or structure.

Escalator – A power-driven, continuously acting, inclined passenger-conveying device.

Fatality – A death causally linked to an incident.

Fuel Oil – A general term for a number of burnable liquids including kerosene, range oil, and home heating oil.

Gasoline – A volatile mixture of liquid hydrocarbons suitable for use in spark-ignition internal combustion engines.

Go-Kart – An amusement device that consists of one or more adult karts or kiddie karts that are driven on a go-kart track. These devices include the pit area and surrounding area, and do not include automobile rides.

Hydrocarbon – An organic compound containing only carbon and hydrogen atoms.

Hydrocarbon Fuel – An organic compound composed of hydrogen and carbon atoms and primarily used as fuel. Classified in two major groups - gaseous fuels (propane and natural gas) and liquid fuels (gasoline, diesel and fuel oil).

Human Error – An inappropriate or undesirable human decision or behaviour that reduces, or has the potential to reduce, effectiveness, safety or system performance.

Incident – An event that upon review suggests that public safety has been compromised.

Leak – A defect in a vessel or other equipment that results in an escape of a fuels product.

Moving Walk – An elevating device that carries passengers on a continuous load-carrying surface that remains substantially parallel to its direction of motion.

Natural Gas – Gas used as fuel and mainly consisting of methane. It is flammable when mixed with air.

Operator – A person who has direct control over the starting, stopping and speed of a device or part thereof, or one who is in charge of the entire operation of a device.

Outside Force – An external force, e.g., vehicle impact, mechanical impact, or natural hazard (lightning), that causes an incident.

Passenger-Carrying Unit – The carrier in an elevating or amusement device that is designed to carry a user or users in a defined path.

POSSE® (Public One Stop Service) – An information technology based work management system that integrates a variety of TSSA activities including permitting and licensing, inspections, enforcement, infrastructure, and asset management.

Periodic Inspection – An inspection that is carried out at regular intervals to ensure compliance with safety regulations.

Pipeline Incidents – Incidents from excavation activities causing damage to natural gas or oil pipelines.

Propane – A gas that is colourless, heavier than air, and odourless at normal temperature and pressure. Propane is flammable when mixed with air, and its vapour can collect in pits, travel long distances and ignite.

Private Fuel Outlet – Any premise with restricted public access where gasoline or an associated product is put into the fuel tanks of motor vehicles or floating motorized watercraft or into portable containers.

Ranger® – A remote system integrated into POSSE® that provides field access to inspectors, and incident investigators who need robust mobile functionality and helps them download assignments to a handheld computer, complete assignments such as inspections, record notes and observations, and upload results into POSSE®.

Rider/User – A person who uses/rides, as a passenger, an elevator, escalator, ski lift or amusement device, or is a user of any kind of equipment that utilizes fuels regulated by TSSA.

RideSmart® – TSSA's RideSmart® program is an ongoing public education initiative which promotes safe use and behaviour to users of amusement devices in Ontario.

Risk-based Inspection – Inspection that targets devices based on information obtained from an analysis of risk factors such as (among others) equipment utilization and age.

Seniors – Persons over 65 years of age.

Spill – An escape of fuels product into the environment or inside a building where the escape is caused by user or operator error.

Serious Injury – An injury in which an individual is admitted to hospital for treatment. Such injuries include burns, fractures, head injuries (concussion), internal injuries and shocks.

Ski Lift (also known as a Passenger Ropeway) – An elevating device designed and constructed to move persons along a horizontal or inclined pathway by means of a hauling rope driven by a non-portable power unit. Types of ski lifts include bar lifts, chair lifts, gondola lifts, reversible ropeways, and rope tows used for snow tubing.

Tube Tow – A tube tow is a type of ski lift that carries a rider in a tube uphill to carry out a new recreational activity that involves tobogganing. The tube is attached to a hauling rope or a handle and is propelled by a tow while remaining in contact with the snow surface.

Water Slide – An amusement device that consists of one or more inclined channels attached to a common platform. These channels contain running water, on which a person slides from a predetermined height into a common splashdown area.

INTRODUCTION

The State of Public Safety report is published annually by the Technical Standards and Safety Authority (TSSA) and details safety-related incidents in the preceding calendar year in Ontario for each of the following TSSA-regulated sectors (program areas) – Boilers and Pressure Vessels/Operating Engineers, Amusement and Elevating Devices (Elevators, Escalators and Ski Lifts), and Fuels (Natural Gas, Propane, Gasoline, Diesel, Fuel Oil).

The State of Public Safety report is produced by TSSA in cooperation with our industry partners who report incidents. The document provides a consolidated picture of safety-related incidents, including causal factors and preventive measures taken by TSSA. It helps identify both potential safety hazards and actions that are being taken to enhance public safety.

TSSA does not claim that this report is a complete summary of every incident that occurred in Ontario in the calendar year 2002. However, as a result of ongoing TSSA/industry communications and education programs, incident reporting continues to improve in all program areas. This year, TSSA continued to receive improved incident reporting, with enhanced quality of data available for causal analysis.

EXECUTIVE SUMMARY

The following represents some of the key themes in the calendar year 2002 State of Public Safety report:

Incidents

TSSA received reports of 5,718 incidents, and has identified no adverse trends of significance in any of the regulated sectors. Through a concerted program of education and information sharing, incident reporting in all program areas has increased and the quality of the data captured in reports has demonstrated continued improvement.

TSSA is currently playing a key role in investigating the causes of two significant fuels incidents:

- > *A natural gas explosion that claimed the lives of seven people on Bloor Street West in Toronto on April 24, 2003.*
- > *A worker death related to an explosion near a natural gas pipeline in Windsor.*

TSSA extends its deepest sympathy to the families of the deceased.

TSSA is working closely with the Ontario Coroner's Office, Municipal officials, the local fire departments and police, the natural gas distributors, and others experts to understand the causes of these incidents so that we can take appropriate measures to prevent their reoccurrence.

These incidents are not included in this report statistics and will be included next year in the State of Safety Report for calendar year 2003.

Serious Injuries and Fatalities

There were 59 serious injuries reported to TSSA (down from 84 serious injuries in 2001). Of these, 70% resulted from human error. Regrettably, there were 9 deaths reported to TSSA, down from 12 deaths in 2001. Human error was responsible for 7 of the 9 fatalities.

Causal Analysis

Human error (user/rider and operator-related) was the most significant causal factor for all reported incidents. Rider error was the prevalent cause of incidents on amusement rides (72%), escalators (80%) and ski lifts (96%). Operator error accounted for 94% of all hydro-carbon fuels-related incidents. Human error (both operator and maintenance-related) was the cause of 40% of Boilers & Pressure Vessels Incidents.

TSSA Actions to Prevent Incidents

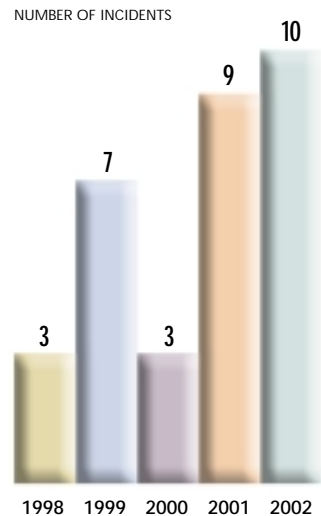
TSSA continues to work with our industry partners to learn from the incident data and use the information to prevent incidents from occurring. Major actions that TSSA undertakes to enhance public safety include:

- > Changes in design in order to achieve safer usage and operation of equipment

- > Changes to codes and regulations to ensure safer standards
- > Training and/or formal certification of individuals who operate and maintain equipment and devices
- > Educating the public on potential safety hazards and proper safety behaviour
- > Bulletins to industry stakeholders on important safety issues
- > Enforcement activities to ensure proper safety compliance
- > Enhancements to TSSA's investigation and causal analysis of incidents.

BOILERS AND PRESSURE VESSELS/OPERATING ENGINEERS

FIGURE 1
TSSA'S FIVE-YEAR ONTARIO
BOILERS AND PRESSURE
VESSELS/OPERATING ENGINEERS
INCIDENTS TREND



Boilers and pressure vessels include equipment used to produce and distribute hot water, steam, compressed air, and a variety of compressed liquids and gases for industrial purposes.

HIGHLIGHTS

■ Incident Statistics:

- > 4 of the 10 incidents involving either Boilers and Pressure Vessels or Operating Engineers were due to operator related causes.
- > One incident that occurred at an operating plant regulated under the Operating Engineers regulations resulted in two fatalities.

■ TSSA Response:

TSSA's certification program for repair and alteration of Boilers and Pressure Vessels has become mandatory. In addition, TSSA is committed to significantly increasing the number of safety-related training seminars delivered to industrial users and contractors who install pressure equipment.

TSSA will initiate a risk based inspection approach developed using risk factors for the inspection of Operating Engineers regulated plants.

BACKGROUND

This section of the State of Safety report summarizes incident information pertaining to the Boilers and Pressure Vessels (BPV) and Operating Engineers (OE) program areas.¹ TSSA is responsible for regulating the safety of all pressure-retaining components manufactured or used in Ontario. Specifically, TSSA inspects pressure equipment during manufacture and once operational, and registers designs of equipment in accordance with recognized codes and standards.

There are approximately 165,000 Boilers and Pressure Vessels operating in Ontario, and this number is growing by approximately 1% each year. In 2002, Boilers and Pressure Vessels were located in 32,583 facilities across the province.²

Boilers and Pressure Vessels incidents typically involve the release of stored energy from pressure-retaining equipment, components, fittings and related devices. In addition to data collected internally, TSSA also refers to information compiled by the National Board of Boiler and Pressure Vessel Inspectors. The National Board, of which TSSA is a member, gathers data from participating North American jurisdictions and inspection (insurance) agencies, thus providing us with access to a comprehensive database for comparison and improvement purposes. In 2002, the National Board reported on approximately 1,690 Boilers and Pressure Vessels incidents in North America.³

TRENDS

Incidents (See Figure 1)

Any incident involving an explosion or rupture of a boiler, pressure vessel, fitting, piping or registered plant equipment, or an incident causing injury or death to a person or property damage, must be reported to TSSA. Each incident is then investigated and corrective action taken where necessary.

In 2002, TSSA received reports for a total of 10 incidents that included 9 Boilers and Pressure Vessels incidents (same as 2001) and one incident that occurred at a facility regulated under the Operating Engineers Regulation (reporting for the first time in 2002). As indicated in Figure 1, the percentage of incidents has remained relatively stable in relation to the increase in the number of the Boilers and Pressure Vessels every year, in the last five years.

In comparison, the number of incidents reported to the National Board in 2002 dropped from 2219 in 2001 to 1663 in 2002. (see Figure 2).⁴ (The National Board indicates that this decrease is partially due to poor incident reporting from insurers of Boilers and Pressure Vessels across North America)

Serious Injuries and Fatalities (See Figure 3)

In 2002, regrettably, two of the 10 incidents, or one-fifth of the total reported to TSSA resulted in fatalities of three maintenance workers. One of the two incidents involved a contractor servicing equipment associated with a refrigeration pressure piping system. The second incident involved the release of steam into a tank resulting in the deaths of two maintenance workers, the cause for which is under investigation. With the exception of these three fatalities, no serious injuries were reported in 2002.

CAUSAL ANALYSIS (Figure 4)

Operator Error

Four incidents resulted from operator and maintenance related causes.

FIGURE 2

NATIONAL BOARD'S 10-YEAR TREND⁵ NORTH AMERICAN BOILERS AND PRESSURE VESSELS INCIDENTS

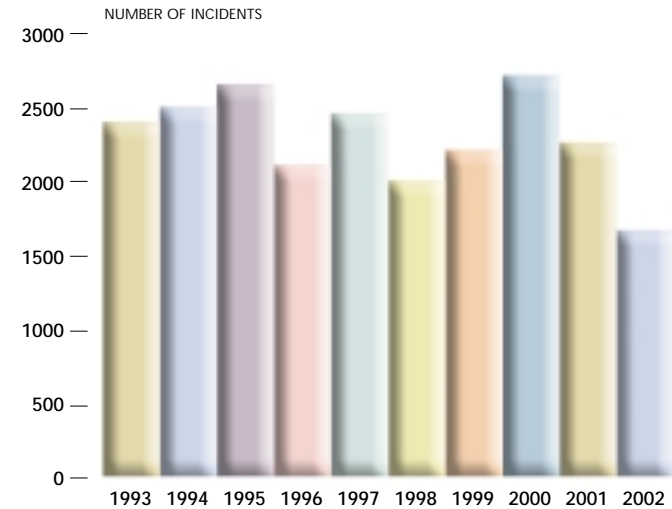


FIGURE 3

FIVE-YEAR TREND – BOILERS AND PRESSURE VESSELS SERIOUS INJURIES AND FATALITIES

NUMBER OF FATALITIES/SERIOUS INJURIES

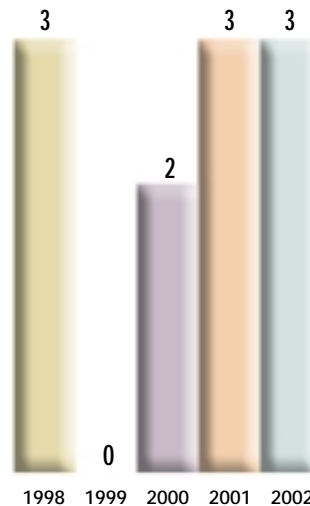
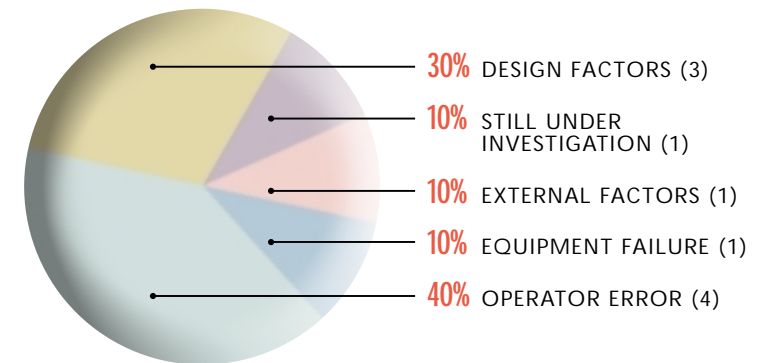


FIGURE 4

BOILERS AND PRESSURE VESSELS INCIDENTS BY CAUSE (TSSA)



¹ Within the Boilers and Pressure Vessels program, certain (registered) plants are required to meet Operating Engineers Regulations that specify qualifications for individuals who operate and maintain them.

² This figure includes 2,745 Operating Engineers-registered plants.

³ The National Board of Boiler and Pressure Vessel Inspectors, 2002 Incident Report

⁴ National Board statistics do not reflect incidents on registered plant equipment beyond Boilers and Pressure Vessels. For that reason, Operating Engineers incidents are not represented on this chart.

⁵ Used by permission of the National Board of Boiler and Pressure Vessel Inspectors.

- > In two incidents, operators failed to develop and/or implement proper procedures; and
- > The remaining two incidents were attributed to poor maintenance of devices

Design Factors

Three incidents involved design related factors:

- > In one incident, the failure and subsequent rupture of a hose in a pressure piping system resulted in a fatality. Additionally, the operators of the location had failed to register the pressure piping system with TSSA, which would have prompted an inspection during which the faulty hose could have potentially been identified. The unsafe pressure piping system was subsequently shut down by TSSA.
- > The second incident involved an explosion caused by the use of an air tank not compliant with the Boilers and Pressure Vessels regulation.
- > The third incident involved the use of equipment designed without appropriate safety protection.

Equipment Failure

Equipment failure resulting from corrosion was the cause identified for one incident.

External Factors

One incident involved factors that did not fall under the jurisdiction of the Boilers and Pressure Vessels and Operating Engineers Regulations. The incident involved the damage of a pressure vessel caused by the leakage of a corrosive substance from an inappropriately placed container.

Cause Under Investigation

The incident that caused the death of two maintenance workers due to release of steam into a tank occurred at a plant regulated by the Operating Engineers Regulations is

currently under investigation by the Ontario Ministry of Labour, with support from TSSA. TSSA has not determined the root cause at the time of publication of this report.

TSSA RESPONSE

TSSA, in consultation with our partners in industry, continues to develop proactive programs aimed at addressing and mitigating Boilers and Pressure Vessels incidents in Ontario:

Mandatory Certification Program

In order to achieve consistency in the installation and maintenance of piping systems, and enhance the awareness of the requirements associated with pressure piping systems, TSSA's certification program has been made mandatory, for piping contractors and organizations involved in repairs and alterations of Boilers and Pressure Vessels. It is anticipated that this program will have a positive impact on performance and quality management and help in reducing design, installation, and maintenance related incidents pertaining to pressure piping systems.

Risk-based Inspection Program (Operating Engineers Registered Plants)

Over the past 3 years, TSSA has assessed all collected data regarding Operating Engineers plants, including violation tracking, in order to identify appropriate risk factors. TSSA will use a risk based inspection approach based on these factors to carry out inspections of the Operating Engineers registered plants.

Ensuring Safety Compliance

TSSA inspectors examine pressurized equipment and facilities prior to start-up and then periodically while in operation to ensure compliance with existing safety standards. Time-sensitive directives are issued for non-compliance. TSSA continues to provide safety-oriented training seminars on a variety of topics such as regulatory requirements, operations and maintenance of equipment and piping systems to industrial users and contractors who install pressure equipment.

Steam Traction Operators Certification

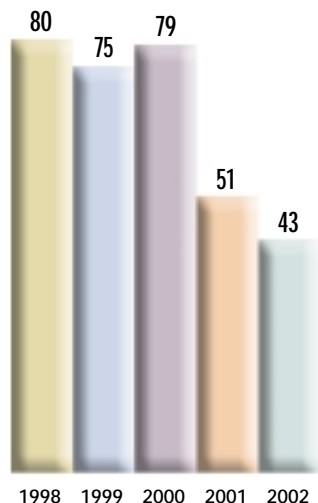
A mandatory certification for operators of steam traction plants was developed in consultation with owners and users. 138 operators were certified in 2002. While there have been no incidents in Ontario involving steam traction engines, in other jurisdictions several incidents including a catastrophic explosion have reinforced TSSA's proactive approach to prevention.

Inspection of Newly Installed Boilers and Pressure Vessels

TSSA will continue to emphasize inspection of Boilers and Pressure Vessels during commissioning, in an effort to ensure that all safety devices have been properly installed prior to operation.

AMUSEMENT DEVICES

FIGURE 5
**FIVE-YEAR TREND –
AMUSEMENT DEVICE INCIDENTS**
NUMBER OF INCIDENTS



An amusement device is a mechanical device or structure used to entertain members of the public by moving them or causing them to be moved. Typical examples include roller coasters, ferris wheels, merry-go-rounds, go-karts, water slides and bungee-type rides and devices.

HIGHLIGHTS

■ Incident Statistics:

> For the past three years, analysis has shown that the majority of all reported amusement device incidents (74% in 2002) occur on three types of devices: water slides, go-karts and roller coasters.

> 72% of all reported amusement device incidents in 2002 were due to a range of rider-related causes.

■ TSSA Response:

TSSA and its industry partners has formed a Risk Reduction Group (RRG) designed to investigate and address root causes of amusement device incidents. The RRG will focus particular attention on better understanding of rider related factors.

In addition to continuing the program at the three major fairs in the province, TSSA's successful RideSmart[®] program will continue to enhance its activities on public education with a focus on water slides and go-karts.

BACKGROUND

TSSA is responsible for regulating the safety of approximately 1,200 amusement devices operating throughout Ontario. TSSA reviews and registers designs, licenses devices when they meet technical code and safety requirements, conducts inspections, investigates incidents, trains and certifies tradespeople who work in the industry, and licenses all owners of amusement devices and rides operating in the province.

In addition, TSSA regularly develops and delivers public education programs on safety as it relates to amusement devices.

TRENDS

Incidents (Figure 5)

In 2002, TSSA received reports of 43 amusement device incidents which was 16% fewer than 2001 (51 incidents). The decrease between 2001 and 2002 can be directly attributed to a marked drop in operator-related incidents. The percentage of operator-related incidents dropped from 13% of all incidents in 2001 to 5% in 2002.

This positive result was influenced by a variety of TSSA/industry initiatives including enhanced operator training, TSSA/industry partnerships with amusement device owners to investigate and address causal factors contributing to amusement devices incidents, and the successful expansion of the RideSmart[®] safety education program. In 2002, in addition to ongoing safety communications to riders of amusement devices, TSSA began targeting RideSmart[®] safety messages to operators.

FIGURE 6
**FIVE-YEAR TREND – AMUSEMENT
 DEVICE SERIOUS INJURIES**
 NUMBER OF SERIOUS INJURIES

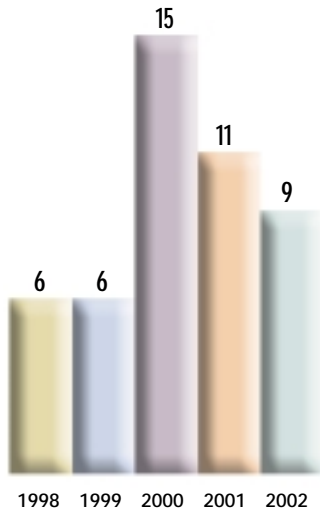
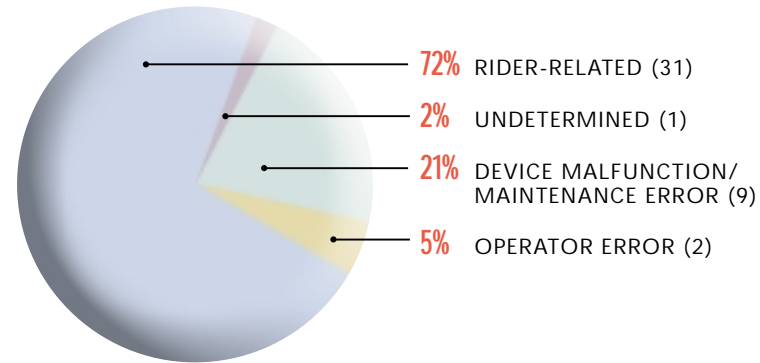


FIGURE 7
AMUSEMENT DEVICE INCIDENTS BY CAUSE



Over the past three years, water slides, Go-Karts and roller coasters together accounted for the majority of all amusement device incidents (74% in 2002, 53% in 2001 and 77% in 2000). In 2002, 18 of the 43 reported amusement device incidents occurred on water slides (42%), seven occurred on Go-Karts (16%) and another seven on roller coasters (16%).

Serious Injuries and Fatalities (Figure 6)

TSSA received reports of nine serious injuries on amusement devices in 2002, down from 11 in 2001. TSSA is pleased to report that there have been no fatalities involving amusement devices over the past five years.

Seven serious injuries were rider-related, the malfunctioning of a go-kart lap belt caused one serious injury, and one serious injury involved an operator being hit by a passenger-carrying unit before the stoppage of a ride. Six of the serious injuries involved children or young adults below the age of 19.

CAUSAL ANALYSIS (Figure 7)

In 2002, TSSA received more complete data related to causal factors and as a result was able to improve causal analysis of incidents. This was achieved through an operator communications program conducted by TSSA and industry partners, and the positive response of ride operators, who have become more disciplined in their approach to reporting. As a result, in 2002 there was only one amusement device incident in which cause was unable to be determined (down from nine in 2001).

Rider-related causes factored into almost three-quarters of all reported amusement device incidents in 2002. Of 43 incidents, 31 (72%) were rider-related. Two of the 43 incidents (5%) involved some degree of operator-related factors. Nine incidents were related to device malfunction or maintenance-related issues.

Typical causal factors for amusement device incidents are as follows:

- > On water slides (18 incidents), rider-related incidents (rider's body parts hitting against the device) accounted

for the majority of incidents. Cause typically included:

- loss of balance; and
- riders being in unsafe positions while traveling down the slide.

- > Six of the seven Go-Kart incidents involved collisions.
 - Rider-related factors included horseplay and unsafe driving.
 - Device malfunction, caused by inadequate maintenance, was also a factor in two Go-Kart incidents.
- > Roller Coasters accounted for seven of the incidents of which:
 - Four were caused by device malfunction or maintenance error (e.g. Failure caused by lack of maintenance of bolts connecting the passenger carrying nits (PCU) and PCU failure resulting from cold weather conditions)
 - Three incidents involved a combination of rider and operator error.

FIGURE 8

AMUSEMENT DEVICE INCIDENTS BY AGE GROUP

NUMBER OF INCIDENTS

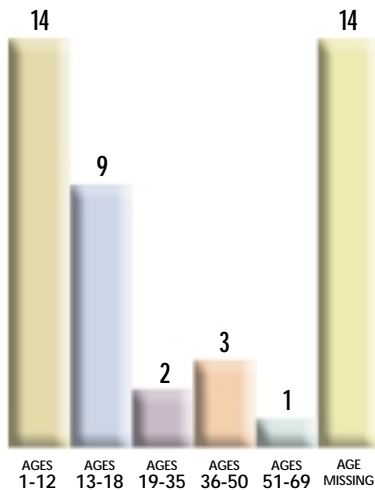


Figure 8 illustrates the most prevalent age group involved in amusement device incidents in 2002 was riders under 12 (14 out of 43 incidents, or 32%), down from 43% in 2001.

TSSA RESPONSE

TSSA is taking the following corrective actions to reduce amusement device incidents involving rider and operator errors, and mechanical issues:

Public Education Programs: RideSmart®

In 2002, TSSA successfully expanded its RideSmart® program with RideSmart® Rest Stops - stations at exhibitions and amusement parks where safety information was delivered to parents and riders in a comfortable, child-friendly setting. Going forward, TSSA is strategically targeting RideSmart® activities to reach riders of water slides and Go-Karts, the devices on which the majority of incidents occur.

Operator Education and Communications Programs: RideSmart®

TSSA's RideSmart® Operator Reward program and the support materials we provided to operators were successful in significantly reducing operator error on amusement devices in 2002. TSSA has initiated a strategy that is focused on encouraging operators to become more directly involved in communicating rider safety, in order to reduce rider-related incidents. TSSA inspectors are also educating every amusement device operator and owner in Ontario on the importance of incident reporting to ensure that we have the best information available to understand safety issues.

Improved Analysis of Root Causes

TSSA will focus on a program of technical skills improvement for inspectors, incident investigators and other relevant staff, with particular attention to causal analysis training. A Risk Reduction Group (RRG), comprising TSSA and industry stakeholders, has been formed to investigate and address causal factors contributing to amusement device incidents. The RRG will pay particular attention to key issues such as rider-related factors and corresponding design/mechanical issues, and will develop action plans to address them.

Enhanced Licensing Requirements for Amusement Device Mechanics

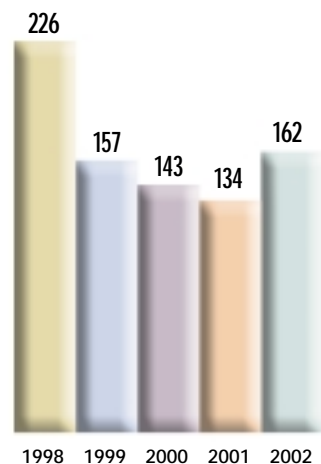
Revisions to regulations and requirements for licensing of amusement device mechanics take effect in 2003 to ensure that only qualified and trained personnel perform the roles as defined in the regulations.

Ensuring Safety Compliance

Inspectors will continue to carry out inspections of all amusement devices found at carnivals, fairs, amusement parks and other commercial venues to ensure compliance with the national standard and applicable safety legislation and issue directives and orders for non-compliant devices. New devices are inspected prior to start-up, and thereafter at the start of every new season or following a device modification.

ELEVATORS

FIGURE 9
**FIVE-YEAR TREND –
ELEVATOR INCIDENTS**
NUMBER OF INCIDENTS



An elevator is a lifting device, equipped with a passenger-carrying unit that moves vertically in guides, that serves two or more floors of a building or structure.

HIGHLIGHTS

■ Incident Statistics:

- > In 2002, factors related to maintenance and/or malfunctioning of devices accounted for 61% of all reported elevator incidents.
- > The two main categories of elevator incidents in 2002 involved passengers hit by closing doors, and trips and falls caused by devices stopping above or below landing areas.

■ TSSA Response:

TSSA and its industry partners are working together to address factors related to maintenance and/or malfunctioning of devices that cause elevator incidents. Enhancements to TSSA's ongoing risk-based inspection program and in-depth causal analysis training for inspectors and investigators will assist in improved understanding of root causes and the development of appropriate mitigation measures.

BACKGROUND

TSSA is responsible for regulating the safety of more than 37,000 elevators across the province. We review and register elevating device designs, conduct initial inspections and license new elevators. TSSA also conducts periodic inspections of operating elevators with frequency of visits based on information obtained from an analysis of risk factors such as device history, equipment utilization and age.

TRENDS

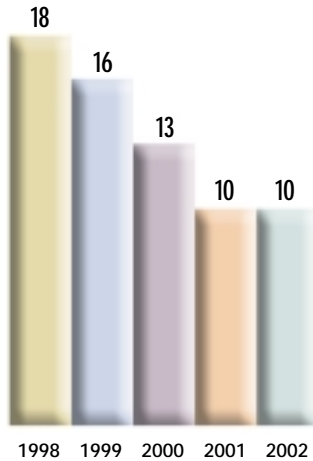
Incidents (See Figure 9)

TSSA received reports of 162 incidents involving elevators in 2002. Although this represents an increase of 28 incidents over 2001, the number of incidents to elevators in operation has remained relatively stable over the last two years in relation to the increase in the number of elevators in the province within that period⁶.

Over the last five years incident reporting and investigation techniques in the industry have shown marked improvement. In particular, TSSA's efforts with industry on improving incident reporting has resulted in more reports, submitted in a timely manner and providing complete data. This enhances the quality of causal analysis of elevator incidents.

⁶ The number of elevators operating in Ontario increased by 12% between 2001 and 2002. Since 1998, the number has risen by 23%.

FIGURE 10
**FIVE-YEAR TREND –
 ELEVATOR SERIOUS INJURIES**
 NUMBER OF SERIOUS INJURIES



Serious Injuries and Fatalities

Of the 162 incidents involving elevators reported in 2002, a total of 10 resulted in serious injuries. Positively, there were no fatalities in 2002 or in any of the previous four years.

The number of serious injuries resulting from elevator incidents has also exhibited a positive downward trend since 1998 (see Figure 10). The implementation of a risk-based inspection program, which uses risk factors such as equipment utilization and age in determining the frequency of visits has influenced a decrease in the number of serious injuries.

CAUSAL ANALYSIS *(Figure 11)*

The cause of 61% of all elevator incidents reported in 2002 (99 out of 162) was attributed to factors related to device maintenance inadequacies and/or device malfunctioning.

Less than one-third (31%, or 51 out of 162 incidents) was attributable to rider-related factors, however this total is up from 20% (28 out of 134 incidents) reported in 2001.

A significant portion of the increase in the actual number of incidents in 2002 involved riders hit by closing

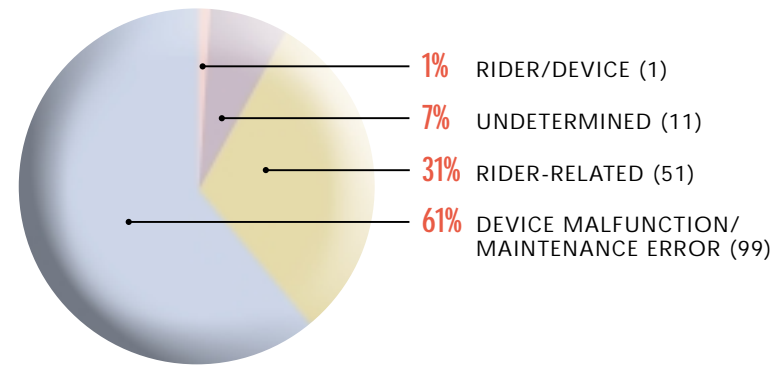
doors (67 incidents in total in 2002, as compared to 45 in 2001). This year TSSA is investigating the causal factors involved in this increase.

Due to much-improved incident classification, incidents in which cause could not be determined dropped from 27% in 2001 to 7% in 2002. Causal analysis training for all Elevating Devices inspectors continues to be a focus for TSSA going forward.

Out of the 10 serious injuries,

- > Three injuries, caused by device-related factors, occurred from falls as a result of the passenger carrying unit coming to a stop above or below the landing area;
- > Three other device-related injuries involved mechanical, electrical or maintenance failures of the passenger-carrying unit;
- > Two injuries caused by rider-related factors involved horseplay in one of the incidents, and functional mobility of the rider in the other incident;

FIGURE 11
ELEVATOR INCIDENTS BY CAUSE



> One injury resulted from a combination of rider/device factors that involved the a visually impaired rider on passenger carrying unit that came to a stop above or below the landing area; and

> Cause was not able to be determined in one serious-injury incident.

While seniors were involved in only 11% of all elevator incidents (18 out of 162) in 2002, they accounted for 40% of all serious injuries reported (four out of ten).

The majority of elevator incidents fall within two categories:

Passenger/Door Collisions

The most commonly occurring incident in 2002 involved riders hit by closing doors, accounting for 41% (67 out of 162), and representing 20% of all serious injuries (2 out of 10).

Cause was related to both rider and device factors, with the most prevalent being:

- > Riders standing too close to closing doors
- > Device malfunction (problems with doors or sensors)
- > Individuals using their hands or feet to open doors

Trips and Falls

20% of all reported incidents (32 out of 162) and half of the serious injuries involved riders tripping and falling upon entering or exiting elevators. As detailed in TSSA's previous years' State of Safety reports, the most common factor in such incidents is an elevator car creating a tripping or falling hazard by coming to a stop above or below the landing area.

Other types of incidents involving trips and falls included turbulent elevator rides (16 incidents) or sudden stops (14 incidents).

TSSA RESPONSE

TSSA is taking the following corrective actions to address elevator incidents in Ontario:

Risk-Based Inspection Program

TSSA's ongoing risk-based inspection program will be enhanced with the implementation of Ranger®, a comprehensive, computer-based investigative tool with field remote capabilities, for Elevating Devices inspectors. Ranger allows data for analysis to be transmitted directly from the field to TSSA's POSSE® information technology system. This enhancement will assist in continually improving the timelines and quality of causal analysis.

TSSA/Industry Working Group

In order to prioritize corrective actions, TSSA and industry partners have identified two main elevator-related issues based on incidents' analysis and risk mapping techniques. These include device-related incidents occurring from rider-door collisions, and trips and falls resulting from the passenger carrying unit coming to a stop above or below

the landing area (accounting for 61% of all incidents). TSSA and industry partners will examine the root cause(s) for these two categories of incidents.

TSSA Staff Skills Training

TSSA will implement a program focusing on technical skills improvement for TSSA inspectors and investigators, with particular attention to causal analysis training.

Industry Communications and Education Program

TSSA will continue its successful communications and education program on awareness of the requirements under the regulations and other topics related to public safety with industry, with focus on property managers who are typically responsible for the safety of elevators on their respective properties.

Ensuring Safety Compliance

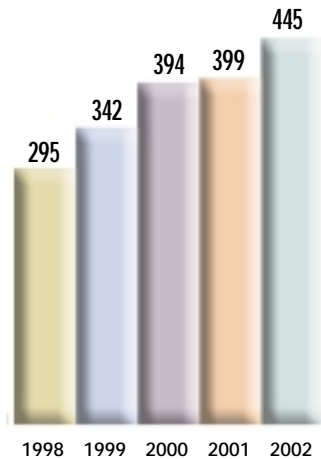
In March 2002, TSSA and the elevator industry introduced a four-year training and apprenticeship program for Class A mechanics or mechanics-in-training, which must be completed before they can be licensed as Elevating Devices Mechanics (EDM-A). An EDM-A may, without supervision, construct, install, alter, repair, service, maintain, or test any class of elevating device as set out in Ontario Regulation 209/01 (Elevating Devices) with some exceptions. This process is intended to influence a positive impact on incidents in the future.

Fire Emergency Operations Training

To address incidents resulting from emergency rescue operations in elevators in Ontario in the past, and as confirmed occurrences in other jurisdictions, TSSA will embark on an expanded training program for firefighters. The program will address the safe use of elevators during emergency situations.

ESCALATORS

FIGURE 12
**FIVE-YEAR TREND –
ESCALATOR INCIDENTS**
NUMBER OF INCIDENTS



An escalator is a power-driven, continuously acting, inclined passenger-conveying device. A moving walk is an elevating device that carries passengers on a continuous load-carrying surface that remains substantially parallel to its direction of motion. In this report, statistics for escalators and moving walks have been combined.

HIGHLIGHTS

■ Incident Statistics:

- > In 2002 incidents involving seniors increased by 37% over 2001.
- > The majority of escalator incidents in 2002 fell into two rider-related categories: falls and entrapment.

■ TSSA Response:

TSSA is working with industry as part of an Escalator Safety Working Group to identify causal factors related to seniors' use of escalators

TSSA and its industry partners will address root causes of rider-related escalator incidents with initiatives that include enhanced technical skills training for inspectors and investigators.

BACKGROUND

TSSA is responsible for regulating the safety of approximately 2,200 escalators and 90 moving walks throughout Ontario. TSSA registers and reviews device designs and conducts periodic inspections of operating escalators and moving walks with frequency of visits based on information obtained from an analysis of risk factors such as device history equipment utilization and age.

TRENDS

Incidents (See Figure 12)

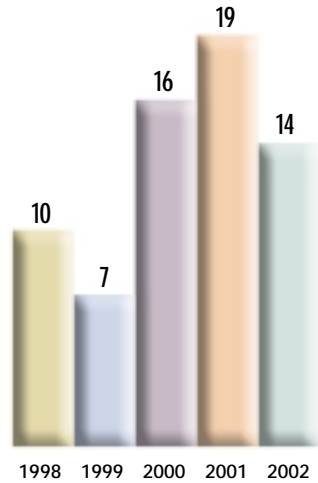
There were reports of 445 escalator incidents in 2002, an increase of 12% over 2001. Since 1998, there has been a consistently upward trend in incidents, which in the past has been attributed to improved reporting. This year, the increase (between 2001 and 2002) includes a rise in the number of escalator incidents involving persons in the 51-65 age group, as well as those over the age of 65. Statistics Canada data indicates an increase in the population of seniors, who due to a variety of contributing factors, such as loss of balance, are more susceptible to escalator incidents.

Compared to 2001, incidents including riders over the age of 65 increased from 86 to 118 (37%), while incidents for riders between 51 and 65 increased from 44 to 60 (36%). All major escalator operators reported increases in these age groups in 2002. In contrast, incidents for riders 35 years old and under dropped by 3% between 2001 and 2002.

FIGURE 13

FIVE-YEAR TREND – ESCALATOR SERIOUS INJURIES

NUMBER OF SERIOUS INJURIES



Serious Injuries and Fatalities (See Figure 13)

In 2002, TSSA received reports of 14 serious injuries involving escalators, a 26% drop from the 19 injuries reported in 2001. In addition, the percentage ratio between total incidents and serious injuries dropped from 5% in 2001 to 3% in 2002. Given the small ratio of serious incidents to devices, analysis of data does not indicate any significant upward or downward trend.

TSSA is pleased to report that no fatalities involving escalators have been reported in the past five years.

CAUSAL ANALYSIS (Figure 14)

As in previous years, rider-related causes accounted for the majority (80%) of all 2002 reported escalator incidents. All of the 14 serious injuries resulted from rider-related causes, with six involving seniors and four involving children.

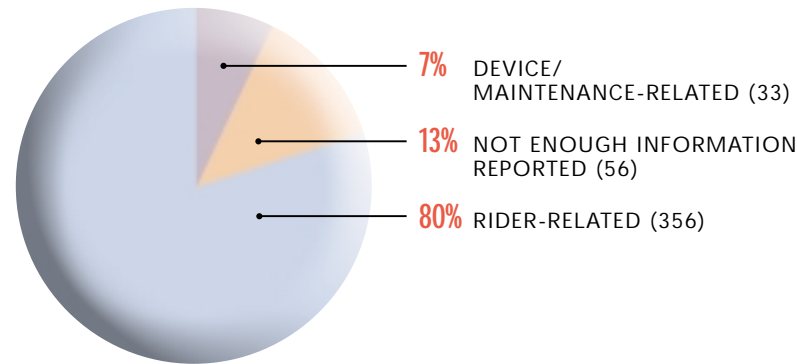
The majority of escalator incidents in 2002 fell into two main rider-related categories:

Falls

78% of all reported escalator incidents involved falls. The most significant causal factor (involving at least 140

FIGURE 14

ESCALATOR INCIDENTS BY CAUSE



incidents) was loss of balance mostly occurring in persons over the age of 65.

In total, 118 escalator incidents involved seniors, a figure that represents 27% of all riders involved in incidents, and 37% (118 out of 321) of riders in the incidents where age information is available. As Figure 15 illustrates, in 2002 the number of incidents in which age-related data was missing has declined by 14, a 10% improvement. This improvement in data has been influenced by the increased diligence on the part of inspectors and relevant TSSA staff collecting, recording, and analyzing incidents.

Escalator-related falls also occur due to presence of foreign objects on the escalators, the inadvertent use of objects such as luggage, strollers or wheelchairs on the escalators, horseplay, rider inattention, and rider intoxication.

Trapping Hazards

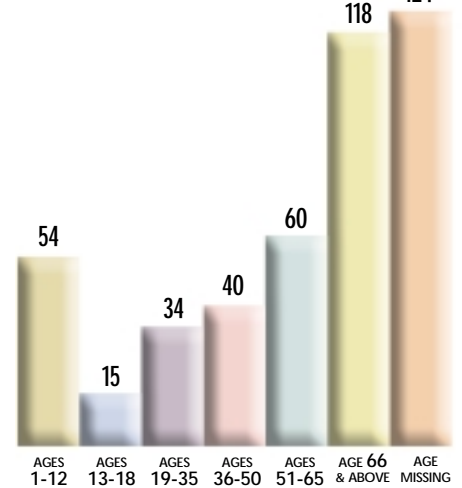
20% of all reported incidents involved riders becoming caught or entangled in some part of the escalator.

Common factors causing these incidents include the wearing of certain types of footwear (for instance, open-toe sandals or high heels) and clothing (long dresses or coats).

FIGURE 15

ESCALATOR INCIDENTS BY AGE GROUP

NUMBER OF INCIDENTS



TSSA RESPONSE

TSSA is taking the following corrective actions to identify hazards, reduce escalator incidents and improve the causal-related data available for analysis.

TSSA/Industry Working Group

TSSA together with the Escalator Safety Working Group, will focus on identifying causal factors related to seniors' use of escalators. The Working Group includes experts on seniors' safety and will develop and implement strategies to increase safety awareness and promote available alternatives.

Strategic Employee Skills Training

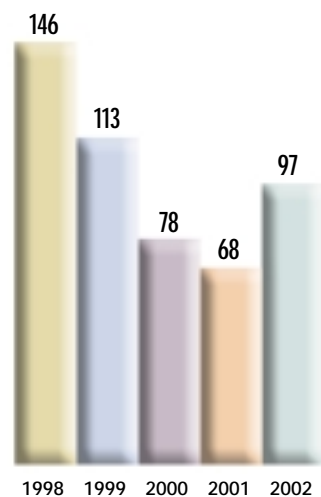
TSSA will focus on a program of technical skills improvement for our staff of inspectors and investigators, with particular attention to causal analysis training.

Report Facilitation

TSSA continues to improve the information collection process by refining reporting forms to make causal information easier to obtain.

SKI LIFTS

FIGURE 16
**FIVE-YEAR TREND –
SKI LIFT INCIDENTS**
NUMBER OF INCIDENTS



Ski lifts (also known as Passenger Ropeways) are elevating devices designed and constructed to move persons along a horizontal or inclined pathway by means of a hauling rope driven by a non-portable power unit. The types of ski lifts include bar lifts, chair lifts, gondola lifts, reversible ropeways, rope tows, and tube tows.

HIGHLIGHTS

■ Incident Statistics:

- > In 2002, 75% of reported ski lift incidents took place on chair lift devices.
- > 96% of all ski lift incidents were due to rider-related causes.

■ TSSA Response:

In 2003, TSSA will undertake a number of new initiatives designed to assist in identifying root causes of ski lift incidents. These programs include improved causal analysis training for inspectors and incident investigators, and enhanced information analysis of falls and incidents involving tube tow detachments.

In the coming year, TSSA and our industry partners will focus on communicating ski safety messages to children, with particular attention to safe use of chair lifts.

BACKGROUND

TSSA is responsible for regulating the safety of 361 ski lifts currently operating in Ontario. TSSA reviews and registers designs, licenses ski lifts that meet technical codes and safety requirements, conducts inspections of operating equipment with the frequency of visits based on information from an analysis of risk factors such as equipment type, age, and inspection history. TSSA also investigates incidents, certifies industry tradespeople, and licenses all owners of ski lifts operating in the province. In addition, TSSA develops and delivers public education programs on safety as it relates to ski lifts.

TRENDS

Incidents (See Figure 16)

In 2002, TSSA received reports of 97 incidents involving ski lifts. This is a 43% increase over the 68 incidents reported in 2001, primarily due to enhanced incident reporting by operators in 2002. To enhance the quality of incident reporting by operators, TSSA improved existing reporting tools and conducted one-on-one communications programs with ski lift operators concerning the importance of incident reporting. The results of these efforts are evident: between January and April of 2002, an average of 18 incidents per month were reported, and at the start of the 2002/2003 ski season, the number had increased to an average of 80 per month.

The majority of all reported ski lift incidents (73 out of 97, or 75%) took place on chair lifts.

FIGURE 17
**FIVE-YEAR TREND –
 SKI LIFT SERIOUS INJURIES**
 NUMBER OF SERIOUS INJURIES

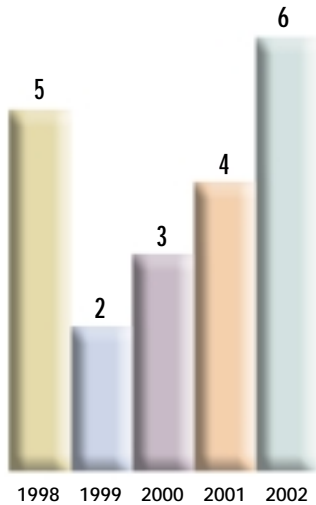


FIGURE 18
SKI LIFT INCIDENTS BY CAUSE

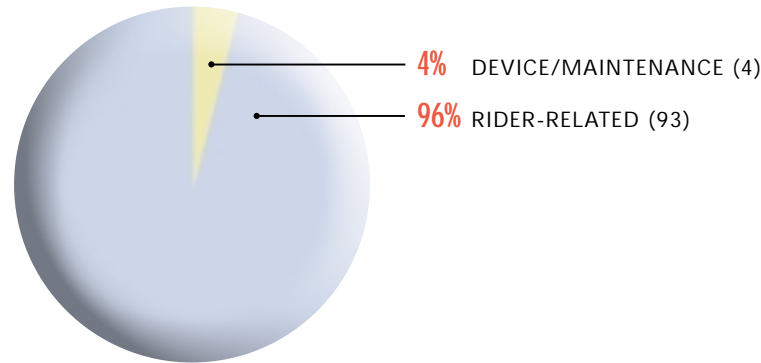
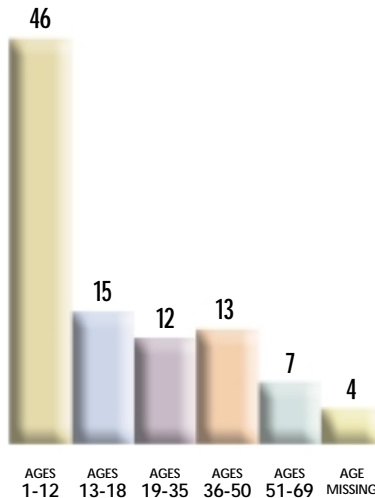


FIGURE 19
SKI LIFT INCIDENTS BY AGE GROUPS
 NUMBER OF INCIDENTS



Serious Injuries and Fatalities

In 2002, six out of 97 reported ski lift incidents resulted in serious injuries, up from 4 in 2001. (see Figure 17).

As indicated in Figure 17, the number of incidents involving serious injuries has been relatively stable over the last 5 years. TSSA is actively involved in analyzing causal factors for incidents including those causing serious injuries.

All six serious injuries occurred on chair lifts. As has been the case for the last five years, there were no fatalities in 2002.

CAUSAL ANALYSIS (Figure 18)

As in previous years, the vast majority of reported ski lift incidents (96%, or 93 out of 97) are rider-related involving either falls or rider-passenger carrying unit collisions and are discussed in detail later in this section. 47% of the reported incidents (46 out of 97) involved riders under the age of 12 (see Figure 19).

Rider-related factors were attributed to all six of the serious injuries caused by falls.

The remaining four incidents were attributed to device malfunction/maintenance factors, of which three involved detachments on snow tubing devices (tube tows), a new type of ski lift that is being used more frequently at ski resorts. Detailed causal analysis of tube tow incidents encompassing design reviews, is being carried out by TSSA in 2003 to improve the safety of these devices.

Ski lift incidents generally involved two rider-related categories:

Falls

43% of all ski lift incidents in 2002 (42 out of 97) involved falls, commonly caused by a rider sitting in a unsafe position in the passenger-carrying unit, loss of balance, premature lifting of the safety bar, or entanglement on the equipment.

Most of the falls in 2002 (23 of the 42 incidents) occurred as the rider was getting off the ski lift. 11 falls

occurred as the rider was getting onto the device and eight occurred during the course of the ride.

Rider/Passenger Carrying Unit Collisions

38% (37 out of 97) of the ski lift incidents involved riders being hit by the ski lift's passenger-carrying unit. Inattention to the approach of this moving device, improper loading and unloading, horseplay, and loss of balance were some of the causal factors involved in this type of incident.

TSSA RESPONSE

TSSA is taking the following corrective actions to improve safety and reduce the number of ski lift incidents:

Public Education Program

TSSA continues to work with industry and safety organizations throughout the province on public education programs in snow and skier safety. In 2003, TSSA will target its communications to children, with particular emphasis on chair lift safety.

Design Review

With the implementation of guidelines for Ontario regulation 209/01 in effect, TSSA in partnership with industry, will undertake a design review of aging ski lifts. While there were no serious incidents involving aging lifts in Ontario in 2002, catastrophic incidents in other jurisdictions have reinforced TSSA's proactive approach to undertake the review on an ongoing basis. The objective of the review is to identify safety issues and provide industry with strategies and action items to address these issues.

Strategic Employee Skills Training

TSSA will focus on a program of technical skills improvement for our staff of inspectors and investigators in 2003, with particular attention to causal analysis training.

Ensuring Safety Compliance

TSSA inspectors will continue to protect the public's exposure to potential safety hazards that may be present in ski lifts.

If hazards exist, inspectors evaluate the amount of risk posed to the public and issue compliance orders to the owners/license holders of the device. In extremely hazardous situations, inspectors have the authority to remove the devices from operation until such hazards are eliminated as indicative by the shutting down of tube tow operations in 2002, in response to the increasing number of recent incidents.

Enhanced Information Analysis

> Analysis of Falls

In the coming year TSSA will undertake a comprehensive causal analysis of falls on ski lifts, including the impact of snowboard use. TSSA will educate ski lift operators on the results of this analysis and work with them to devise appropriate risk control strategies.

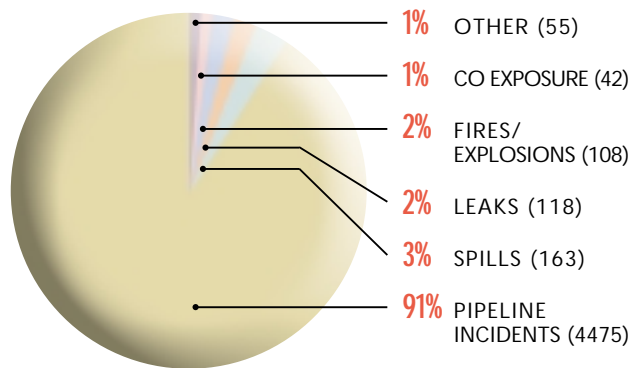
> Tube Tow Detachments

Prior to the 2003-2004 ski season, TSSA will work with industry to analyze causes of tube tow detachments and will establish an action plan to reduce incidents and resulting injuries.

FUELS

FIGURE 20

ALL REPORTED FUEL INCIDENTS (BY TYPE)



Hydrocarbon fuels, regulated by TSSA, consist of two main types: gaseous fuels (e.g. propane and natural gas) and liquid fuels (e.g. gasoline, diesel and fuel oil). Solid fuel (for instance, wood and coal) is outside TSSA's jurisdiction.

HIGHLIGHTS

■ Incident Statistics:

- > In 2002, 4,961 incidents were reported either directly or indirectly to TSSA.
- > In 2002, 20 serious injuries and six fatalities resulted from fuel-related incidents.
- > TSSA has focused significantly greater resources on investigating incidents.

■ TSSA Response:

TSSA is engaging in a range of activities such as public and industry education, enforcement, ensuring safety compliance and identifying enhancements in equipment design and manufacture to reduce fuels-related incidents and serious injuries.

BACKGROUND

TSSA regulates the safe transportation, storage, handling and use of hydrocarbon fuels, licenses fuel facilities, registers contractors and certifies tradespeople who install and service equipment. Additionally, TSSA reviews and approves facility plans and standards for equipment and appliances.

Types of Fuels

Each type of hydrocarbon fuel (propane, natural gas, gasoline, diesel and fuel oil) differs in terms of its hazardous properties, utilization, methods of storage and transportation, the degree to which the public comes into contact with the product, and other factors. The nature of incidents is also related to how devices and equipment are used, operated, maintained or designed rather than to the type of fuel used. For these reasons, there is no comparison of fuel types in the analysis of incidents. In this report, discussions of safety statistics and TSSA action plans pertaining to each fuel type follow general observations and factors related to all fuels.

Incidents

In 2002, 4,961 incidents were reported either directly to TSSA, to natural gas distributors (who receive reports of pipeline incidents involving damage to distribution systems during excavation work) and to the Spills Action Centre (SAC) of the Ministry of Environment. (Figure 20). This represented an 18% decrease from the 6,063 incidents reported in 2001. TSSA also receives information on the

numbers of calls and injuries reported to Ontario fire departments from the Ontario Fire Marshal's office. Statistics from 2002 were not available in time for publication.

The majority (91%) of these 4,961 incidents in 2002 involved pipeline excavations. Over the past five years, the significant majority of reports detailing contact with underground pipelines resulting from improper excavation practices have been minor in nature. Extensive detail on pipeline incidents and TSSA actions to reduce them is provided in the Natural Gas Pipelines section.

The most serious carbon monoxide (CO) incidents related to fuels-burning equipment (42 in 2002) were reported to and investigated by TSSA. TSSA also tracks CO exposure information provided from the Ontario Fire Marshal's Office. In 2001, the Ontario Fire Marshal's office reported 10,603 calls and false alarms from the public in response to concerns about some type of CO exposure.

Investigations

In 2002, TSSA conducted field investigations into 759 fuel-related incidents. This represents a significant increase (73%, 315 more investigations) over 2001 (Figure 21).

In 2002, TSSA continued to focus and devote greater resources on investigating incidents that have the greatest impact on public safety and the environment leading to the increase in the number of investigations. For example, TSSA is responding to the large volume and potential severity of natural gas pipeline incidents by enhancing the quality and increasing the number of investigations (428 pipeline incident investigations, 56% of total) (Figure 22). This allows TSSA to effectively identify root causes behind these incidents and ensure that proper pipeline excavation and location practices are being followed.

Serious Injuries and Fatalities

In 2002, 20 serious injuries and six fatalities resulted from fuel-related incidents (See Figure 23). The data illustrates fluctuations in serious injuries and fatalities within a range of 15 to 49.

FIGURE 21
FIVE-YEAR TREND – INVESTIGATED FUEL INCIDENTS
 NUMBER OF INCIDENTS

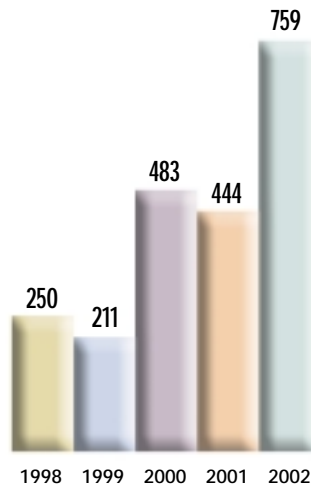


FIGURE 22
ALL INVESTIGATED FUEL INCIDENTS (BY TYPE)

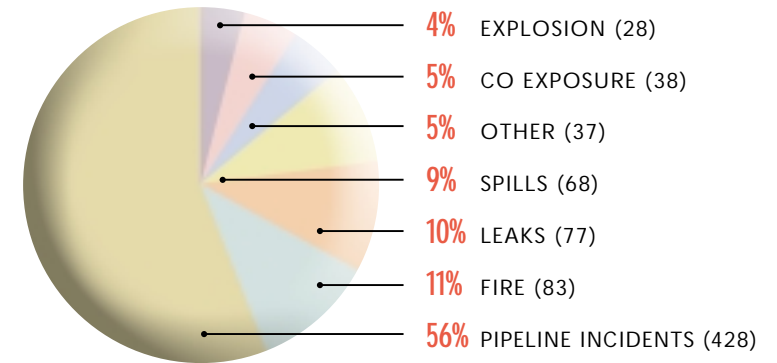
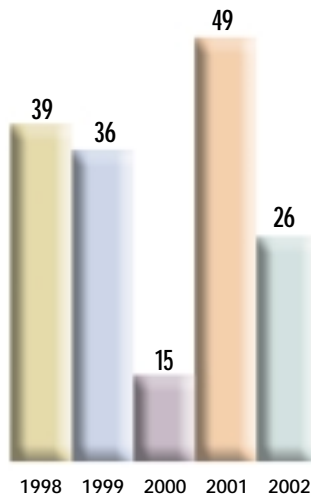


FIGURE 23
FIVE-YEAR TREND – SERIOUS INJURIES AND FATALITIES (INVESTIGATED FUEL-RELATED INCIDENTS)
 NUMBER OF SERIOUS INJURIES AND FATALITIES



CAUSAL ANALYSIS

Human error (such as improper use or maintenance of equipment) factored in 13 of the 20 serious injuries, while mechanical failure or device malfunction was a factor in one of the serious injuries. Human error was also a factor in all six of the fatalities. Improper use of propane equipment at campsites or in residential vehicles contributed to all six deaths. More detailed causal analysis of incidents for each hydrocarbon fuel is provided within each of the fuel type sections.

TSSA RESPONSE (APPLIES IN ALL FUELS SECTORS)

The following action items apply to all hydrocarbon fuels. Further detail on TSSA actions, specific to each fuels sector is contained in each of the fuel type sections.

Enhanced Public Education

- > Reduction of CO incidents has been identified as a key priority for public education at TSSA. In an effort to reduce CO incidents, TSSA and our industry partners will develop a new communications program. This program will be directed to residential homeowners, promoting safe use and maintenance of fuel-burning appliances.
- > TSSA is extensively involved in providing safety messaging and support to the Ontario Fire Marshal's Public Fire Safety Council Spring / Summer Safety program. The program focuses on such areas as barbecue safety, cottage safety and outdoor safety (safe use of portable fuel burning appliances for camping, fishing).

Ensuring Safety Compliance

- > TSSA has significantly increased the number of Fuels Safety inspectors in Ontario from 19 in 1996 to 34 in 2003 to enhance enforcement activity and improve compliance with Ontario safety laws.

- > The Administrative Penalties Program, introduced by TSSA in 2002, has been created as a way to promote safety and compliance. TSSA is imposing fines on users, operators and contractors in situations where there has been persistent or deliberate non-compliance to safety regulations.

Improved Design and Manufacturing of Fuels Appliances and Equipment

TSSA continues to work with manufacturers of fuels appliances on improving the design and manufacture of fuels appliances. This involves analyzing appliances to identify key design improvements and retrofits. Some current examples of work that TSSA and manufacturers have been doing are included in the specific fuels sections.

DIESEL

HIGHLIGHTS

■ Incident Statistics

- > The majority (93%) of reported diesel-related incidents involved either spills or leaks from equipment.
- > In 2002, human error was a causal factor in 61% of reported diesel incidents.

■ TSSA Response

TSSA will review and analyze unsafe behaviour of drivers causing spills while filling their vehicles with diesel at service stations and use this information to develop effective public education strategies. TSSA will be continuing its successful safety compliance activities for service stations and will also work with industry on a safety management plan for private fuels outlets.

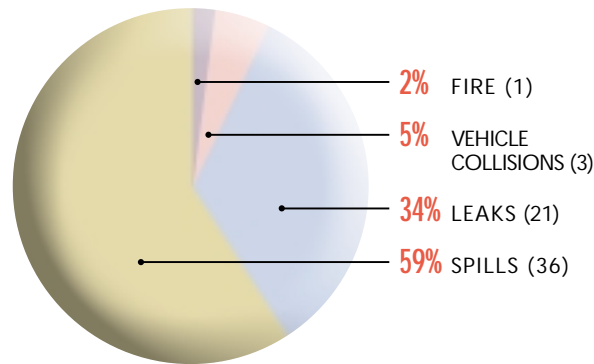
BACKGROUND

Diesel is used as a fuel in commercial and off-road vehicles and internal combustion engines used to drive energizing generators and pumps. It is stored at ambient temperature in tanks and is transported by truck, rail and pipeline. Diesel represents approximately 6% of the total transportation fuel usage.

Incidents

In 2002, TSSA received reports of 61 diesel incidents, and 20 (33%) warranted investigation. TSSA licensing, engineering review, audit and investigation activities have significantly contributed to ensuring that the number of diesel incidents continues to remain low. The majority (93%) of reported diesel-related incidents involved either

FIGURE 24
REPORTED DIESEL INCIDENTS BY TYPE



spills (36) or leaks from equipment (21) such as faulty tanks, hoses and/or nozzles in dispensers. (Figure 24)

In 2002, diesel incidents occurred in a variety of locations, most commonly in bulk plants, service stations and private fuels outlets. (Figure 25)

Serious Injuries and Fatalities

In 2002, there was one serious injury involving a diesel fire when a worker suffered severe burns while dispensing diesel fuel.

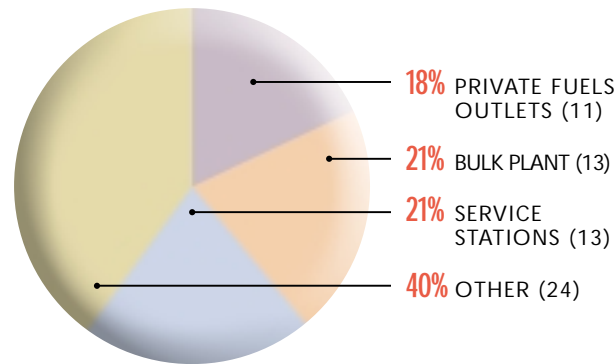
CAUSAL ANALYSIS (Figure 26)

Human error was a causal factor in 37 out of 61 reported incidents (61%). The majority of these cases occurred at service stations, usually involving drivers over-filling a diesel tank.

Device failure was a factor in 21 out of 61 of diesel incidents (34%). The most common device-related factors in these types of incidents involve faulty hoses and/or nozzles in dispensers.

The cause of the single serious injury, involving the diesel fire, was attributed to improper work practices.

FIGURE 25
REPORTED DIESEL INCIDENTS BY OPERATION TYPE



TSSA RESPONSE (specific to diesel)

Improved Analysis of Root Causes

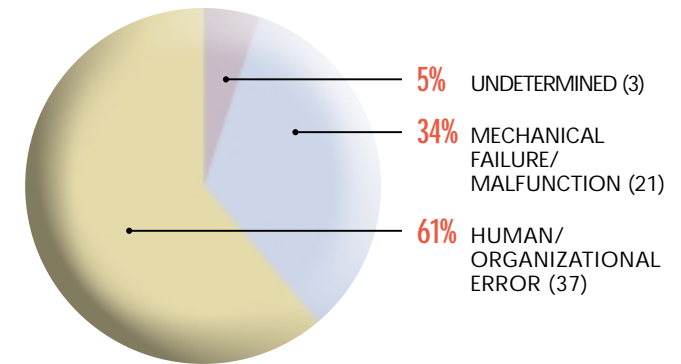
TSSA will review and analyze unsafe behaviour of drivers causing spills while filling their vehicles with diesel at service stations. The analysis will include review of whether public education would be effective in encouraging safer driver behaviour.

Ensuring Safety Compliance

While the vast majority of spills involve minor quantities of fuel, ensuring adequate spill containment is paramount to controlling spills that can cause significant environmental damage. TSSA continues to engage in a number of activities to ensure that safety hazards are managed through proper equipment maintenance, spill control and spill prevention measures at service stations. These activities include:

- > Expanding the number of audit inspectors to ensure regular, periodic inspection of service stations in Ontario and enhanced investigation of safety-related complaints.

FIGURE 26
REPORTED DIESEL INCIDENTS BY CAUSE



- > Targeted inspections of fuels transporters to ensure proper vehicular maintenance.

- > Enforcing and supporting industry efforts to comply with provincial codes and regulations introduced in 2001 that are aimed at reducing diesel leaks and spills used in generators. These regulations include a phased-in program to verify compliance of fuels systems (including piping, venting and associated tanks). For underground tanks, a registration requirement and a multi-year program is in place to upgrade tanks either through installation of spill and leak prevention equipment or tank removal.

Effective Safety Management

In order to ensure proper safety compliance for all private fuel outlets, TSSA is working with a group of industry representatives to develop a safety management plan to properly address any identified safety risks.

FUEL OIL

HIGHLIGHTS

■ Incident Statistics

> In 2002, the majority (87%) of reported fuel oil incidents involved leaks and spills.

> In 2002, mechanical failure or device malfunction was identified as a factor in the majority of reported fuel oil incidents. Corrosion in aging tanks or in those located above ground was the most prevalent cause of mechanical failure.

■ TSSA Response

TSSA will continue to focus on ensuring owners of fuel oil heating systems understand what their inspection requirements are and will continue to enforce and support industry efforts to comply with provincial codes and regulations requiring upgrading or removal of aging tanks.

BACKGROUND

Fuel oil is a general term for a number of combustible liquids including kerosene, home heating oil, and Bunker C (fuel oil used in furnaces). It is stored in tanks at ambient pressure and transported by tank trucks, rail and pipeline.

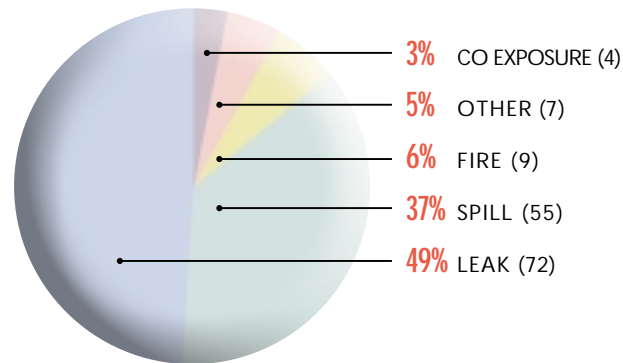
Fuel oil is used mainly for home heating, but is also used in industrial applications as boiler fuel and, in smaller quantities, in lanterns, backup generators, space heaters and camp stoves. Fuel oil represents approximately 15% of fuel consumption for heating purposes.

Incidents

There were 147 fuel oil incidents reported in Ontario in 2002. TSSA conducted field investigations for any incident where there was a potential safety hazard to the public.

FIGURE 27

REPORTED FUEL OIL INCIDENTS BY TYPE



There were 120 TSSA field investigations (82% of all reported fuel oil incidents) in 2002.

In 2002, 87% of reported fuel oil incidents involved leaks (49%, 72 incidents) and spills (37%, 55 incidents). (Figure 27) While four incidents involved CO-exposure, one of these resulted in four serious injuries. The other incidents resulted in either minor or no injuries.

Ninety-one percent of all fuel oil incidents in 2002 took place where the fuel was being used for heating. (Figure 28)

Serious Injuries and Fatalities

In 2002, there were four serious injuries all resulting from a single incident involving carbon monoxide exposure. There were no fatalities.

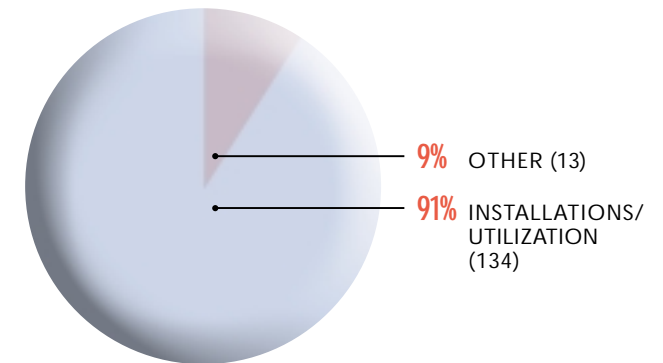
CAUSAL ANALYSIS (Figure 29)

Mechanical failure was identified as the most significant factor in 50% (74 out of 147) of reported fuel oil incidents. The most prevalent factor behind these types of incidents is corrosion, particularly in aging storage tanks or those exposed to severe weather conditions.

Human error was identified as the causal factor in 20% (29 out of 147) of reported incidents. The most

FIGURE 28

REPORTED FUEL OIL INCIDENTS BY OPERATION TYPE



prevalent human-error related factor in these types of incidents is supplier error (usually overfilling of tanks). The cause in the CO exposure incident that resulted in four serious injuries was attributed to the lack of furnace maintenance.

Cause was not determined in 44 reported incidents (30%). In most of these cases, full investigation was difficult, as critical evidence had been destroyed in the incident's fire or explosion. Also, fuel oil spills often occur slowly over long periods of time, further impeding accurate causal analysis.

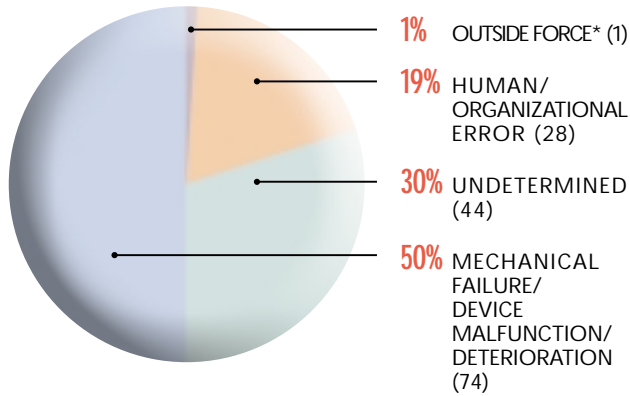
TSSA RESPONSE (specific to fuel oil)

Ensuring Safety Compliance

TSSA continues to enforce and support industry efforts to comply with provincial codes and regulations introduced in 2001 that are aimed at reducing diesel leaks and spills. These regulations include a phased-in program to verify compliance of fuels systems (including piping, venting and associated tanks). For underground tanks, a registration requirement and a multi-year program to upgrade tanks (either by including spill and leak prevention equipment or tank removal) is in place.

FIGURE 29

REPORTED FUEL OIL INCIDENTS BY CAUSE



* Incident is caused by an external force, e.g., vehicle impact, mechanical impact, or natural hazard (lightning).

Expanded Communications

TSSA has expanded its safety communications to owners of fuel oil heating systems in order to reduce leaks and equipment malfunction. Examples of safety information that are being provided to owners include requirements for:

- > Inspection by qualified oil burner technicians to ensure effective maintenance of fuel systems.
- > Registration of underground (buried) storage tanks to ensure they are tracked and inspected over time. Fuel oil distributors must inspect all equipment, both above and below ground, upon initial delivery and at least once every 10 years.

Improved Equipment Design

In 2002, in order to address incidents of CO exposure, TSSA proposed safety-related changes to design standards for fuel oil appliances. The CSA Technical Committee on Oil Burning Equipment subsequently accepted these changes and all such appliances are required to have safety devices that shut down equipment when there is a blocked chimney or vent.

GASOLINE

HIGHLIGHTS

Incident Statistics

> In 2002, the majority of reported gasoline incidents in Ontario involved either spills or leaks from equipment. Together, these two categories make up 83% of all gasoline incidents.

> In 2002, human error was a causal factor in 67% of reported gasoline incidents. Overfilling of tanks and driving away with dispenser nozzles still in the gasoline tank were the most common errors for drivers filling their vehicles with gasoline at service stations.

> The vast majority of reported incidents (82%) took place at service stations.

TSSA Response

TSSA will review and analyze unsafe behaviour of drivers causing spills while filling their vehicles at service stations and use this information to develop effective public education strategies. TSSA will be continuing its successful safety compliance activities for service stations and will also work with industry on a safety management plan for private fuels outlets.

BACKGROUND

Gasoline is used as a fuel in the internal combustion engines of personal and commercial vehicles such as boats, cars, trucks and snowmobiles. This fuel is stored in tanks at ambient temperature and pressure, and is transported by truck, rail and pipelines. Its handling, dispensing, transportation and use require a high degree of human interaction.

Gasoline represents approximately 93% of total transportation fuel usage.

Incidents

In 2002, TSSA received reports of 116 gasoline incidents. Of these, 18% (21 incidents) were investigated by TSSA. TSSA licensing, engineering review, audit and investigation activities have significantly contributed to ensuring that the number of gasoline incidents continues to remain low.

In 2002, the majority of reported gasoline incidents in Ontario involved either spills (72 incidents) or leaks from equipment (25 incidents) such as faulty tanks, hoses and/or nozzles in dispensers. Together, these two types make up 83% of all gasoline incidents. (See Figure 30): The majority (82%, 94 out of 116) of reported gasoline incidents took place at retail gasoline stations. (See Figure 31)

Serious Injuries and Fatalities

TSSA is pleased to report that there were no serious injuries or fatalities involving gasoline in 2002.

FIGURE 30

REPORTED GASOLINE INCIDENTS BY TYPE

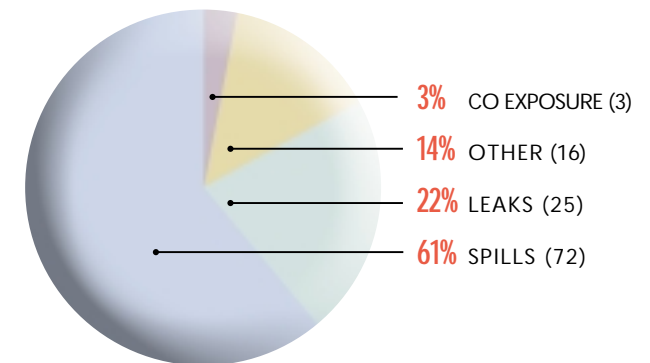


FIGURE 31

REPORTED GASOLINE INCIDENTS BY OPERATION TYPE

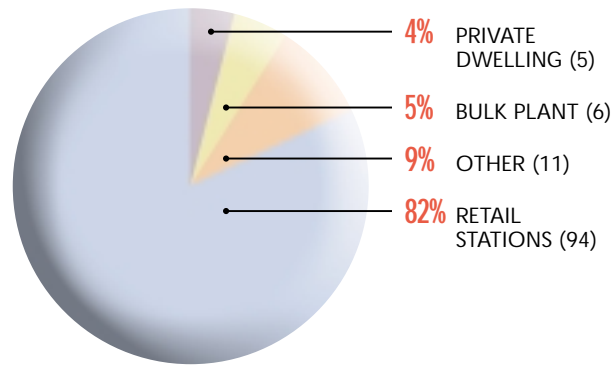
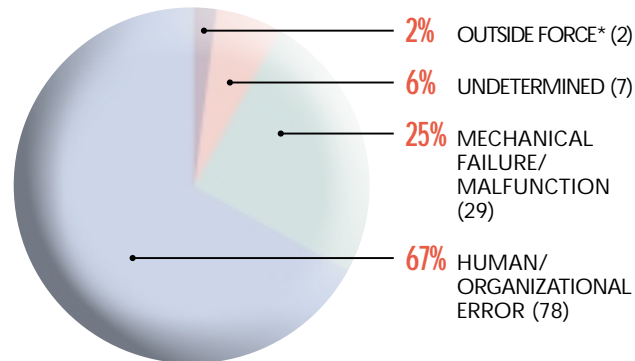


FIGURE 32

REPORTED GASOLINE INCIDENTS BY CAUSE



* Incident is caused by an external force, e.g., vehicle impact, mechanical impact, or natural hazard (lightning).

CAUSAL ANALYSIS (Figure 32)

Human error was a factor in 78 out of 116 reported incidents (67%). The majority of these cases involved drivers filling their vehicles with gasoline at service stations, where there was either over-filling of the tank or driving away with the dispenser nozzle still attached to the vehicle.

Device failure was the cause of 25% of gasoline incidents (29 out of 116). The most common device-related factors in these types of incidents involve faulty hoses and/or nozzles on dispensers.

TSSA RESPONSE (specific to gasoline)

Improved Analysis of Root Causes

TSSA will review and analyze unsafe behaviour of drivers causing spills while filling their vehicles at service stations. The analysis will include review of whether public education would be effective in encouraging safer driver behaviour.

Ensuring Safety Compliance

While the vast majority of spills involve minor quantities of fuel, ensuring adequate spill containment is paramount to controlling spills that can cause significant environmental damage. TSSA continues to engage in a number of activities to ensure that safety hazards are managed through proper equipment maintenance, spill control and spill prevention measures at service stations. These activities include:

- > Expanding the number of audit inspectors to ensure regular, periodic inspection of service stations in Ontario and enhanced investigation of safety-related complaints at service stations.
- > Targeted inspections of fuels transporters to ensure proper vehicular maintenance.

Effective Safety Management

In order to ensure proper safety compliance for all private fuel outlets, TSSA is working with a group of industry representatives to develop a safety management plan to properly address any identified safety risks.

NATURAL GAS

(EXCLUDING PIPELINES)

HIGHLIGHTS

■ Incident Statistics

- > The majority of natural gas incidents (81%) were either fires/explosions or CO exposure.
- > In 2002, eleven serious injuries resulted from reported natural gas incidents.

■ TSSA Response

- > It is important that residential homeowners understand the importance of maintaining fuel-burning equipment such as furnaces. TSSA and our industry partners will develop a new program educating the public on furnace maintenance to prevent the occurrence of CO incidents. TSSA is also continuing its enforcement activities to ensure effective equipment maintenance and is working with manufacturers to improve design and manufacture of fuels equipment.

BACKGROUND

Natural Gas is widely used as fuel for residential heating and in commercial or industrial applications. To a limited extent, it is also used as a vehicle fuel. Natural gas accounts for approximately 75% of total fuel consumption used for heating purposes.

Incidents

There were 125 natural gas incidents (excluding pipeline incidents) reported to and investigated by TSSA in 2002 (Figure 33). The two major types of these natural gas incidents were fires/explosions (67 incidents) and CO exposure (34 incidents). Serious CO exposure incidents related to fuels-burning equipment are investigated by

FIGURE 33

REPORTED NATURAL GAS INCIDENTS BY TYPE

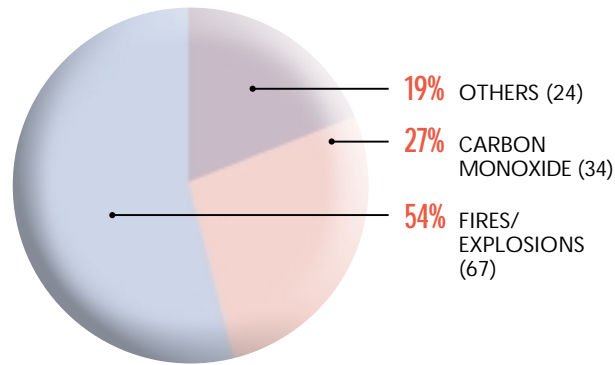
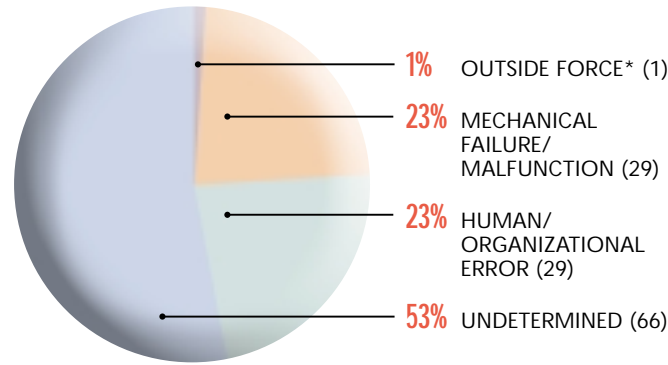


FIGURE 34

REPORTED NATURAL GAS INCIDENTS (EXCLUDING PIPELINE INCIDENTS) BY CAUSE



* Incident is caused by an external force, e.g., vehicle impact, mechanical impact, or natural hazard (lightning).

TSSA. TSSA places strong emphasis on reducing CO exposure from faulty or poorly maintained fuel-burning equipment such as residential furnaces due to the potential for serious injury or death.

Serious Injuries and Fatalities

In 2002, eleven serious injuries resulted from reported natural gas incidents. These injuries were caused by either fires/explosions (6) or CO exposure (5). Some of the causal factors behind these serious injuries include poor furnace maintenance, lack of proper procedures in the usage of equipment and device malfunction. TSSA is pleased to report that there were no fatalities from natural gas incidents in 2002.

CAUSAL ANALYSIS

For natural gas incidents (Figure 34) (excluding pipeline incidents), causal factors (where cause was determined) were evenly divided between:

- > Human error (23%), mainly resulting from poor maintenance of fuel-burning equipment;

- > Device-related (23%), including corrosion and failure of design and/or components such as compressors, regulators, valves and protective elements.

For incidents where cause was undetermined (53%), full investigation was limited because critical evidence had been destroyed in the incident's fire or explosion.

TSSA RESPONSE (specific to natural gas – excluding pipelines)

ACTION ITEMS

Enhanced Public Education

The new CO safety communication program developed by TSSA and our industry partners will educate residential homeowners on how safe use and maintenance of fuel-burning appliances can reduce the likelihood of being exposed to carbon monoxide.

Ensuring Safety Compliance

The Administrative Penalties Program has been introduced by TSSA to ensure full safety compliance for fuels contractors

to ensure proper maintenance of fuel-burning equipment such as residential furnaces. The new program allows TSSA to impose an immediate fine for safety non-compliance. TSSA prosecutes offenders in the most serious instances of unsafe activity.

Improved Design and Manufacturing of Fuels Appliances

TSSA continues to work with manufacturers of fuel appliances on improving their design and manufacture to prevent fires, explosions and CO exposure. This involves analyzing appliances to identify key design improvements and retrofits. Some current examples of work that TSSA and manufacturers have been involved in natural gas include:

- > Working with a major appliance manufacturer to correct potential CO leakage and flame roll-out in water heaters.
- > Refitting fireplaces to prevent the potential of explosions.

NATURAL GAS

(PIPELINES)

TSSA is currently playing a key role in investigating the causes of two significant fuels incidents:

- > A natural gas explosion that claimed the lives of seven people on Bloor Street West in Toronto on April 24, 2003.
- > A worker death related to an explosion near a natural gas pipeline in Windsor.

TSSA extends its deepest sympathy to the families of the deceased.

TSSA is working closely with the Ontario Coroner's Office, Municipal officials, the local fire departments and police, the natural gas distributors, and others experts to understand the causes of these incidents so that we can take appropriate measures to prevent their reoccurrence.

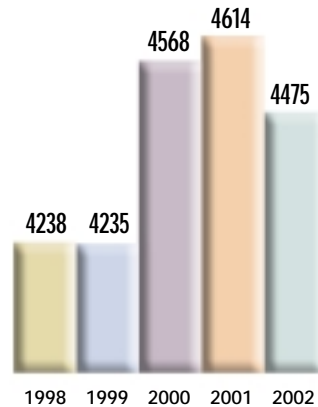
These incidents are not included in this report statistics and will be included next year in the State of Safety Report for calendar year 2003.

HIGHLIGHTS

■ Incident Statistics

- > In 2002, there were 4,475 reported natural gas pipeline incidents.
- > In 2002, no serious injuries or fatalities resulted from reported natural gas pipeline incidents.
- > The cause of excavation-related pipeline incidents involved either failure to locate buried lines prior to

FIGURE 35
FIVE-YEAR TREND – NATURAL GAS PIPELINE INCIDENTS REPORTED BY DISTRIBUTORS
NUMBER OF INCIDENTS

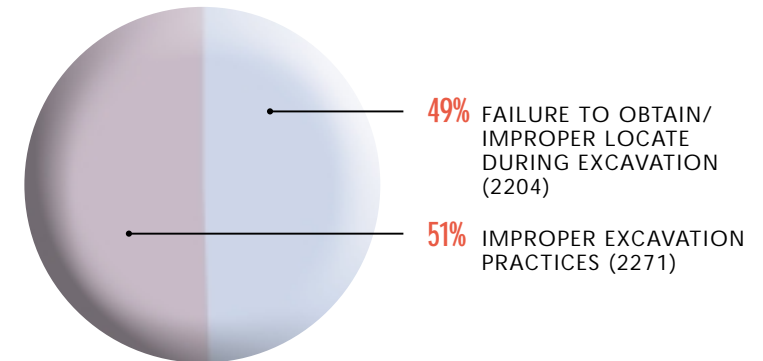


excavation or failure to follow safety procedures when working in the vicinity of these lines.

■ TSSA Response

- > Investigating pipeline incidents and educating Ontario utilities, contractors, major companies and industry associations on proper pipeline location and excavation practices is a key TSSA priority and has resulted in increases in TSSA investigations.
- > TSSA is working closely with industry partners in the Ontario Regional Common Ground Alliance to prevent natural gas pipeline incidents through a combination of effective enforcement activity and greater safety education and training for workers and the public who are working with, or near natural gas pipelines.
- > TSSA inspects natural gas pipelines and investigates serious incidents to ensure safety compliance. TSSA also issues safety directives and fines and prosecute individuals

FIGURE 36
REPORTED PIPELINE INCIDENTS BY CAUSE



engaging in unsafe practices in the most serious instances.

BACKGROUND

Natural Gas is transported and distributed by underground pipeline systems. TSSA reports on natural gas pipeline incidents collected by major gas distribution companies.

Incidents

There were 4,475 natural gas pipeline incidents reported to TSSA by distribution companies in Ontario in 2002 (Figure 35). Of these, 426 were investigated by TSSA. While Ontario's construction industry has been robust, the number of incidents resulting from pipeline incidents during excavations decreased by 3% in 2002 from the previous year.

A significant number of these incidents are minor in nature. Many of these incidents result either from improper excavation practices or homeowners and contractors who have failed to report to their natural gas utility before digging and have scraped or damaged underground gas

lines. TSSA has made reduction of natural gas pipeline incidents a key priority due to the large volume and potential severity of these types of events. As a result, TSSA is conducting more investigations to ensure that proper excavation and pipeline location practices are being followed.

Serious Injuries and Fatalities

TSSA is pleased to report that there were no serious injuries or fatalities involving natural gas pipelines in 2002.

CAUSAL ANALYSIS

For excavation-related incidents (Figure 36), causal factors continue to be evenly divided between:

- > Failure to follow safety guidelines when working in the vicinity of buried natural gas pipelines (2,271 excavation-related incidents, 50.7%);
- > Failure to locate (or accurately locate) buried natural gas pipelines before conducting excavation work (2,204 excavation-related incidents, 49.3%).

TSSA RESPONSE *(specific to natural gas pipelines)*

Expanded Industry Communications and Education

- > TSSA delivered safety information seminars related to proper pipeline location and excavation practices to more than 2,100 excavators in Ontario in 2002. The program will be expanded to reach an even greater number of excavators, particularly small contractors.
- > In 2002, TSSA enhanced the Guidelines for Excavation in the Vicinity of Gas Lines, covering proper excavation procedures and pre-excavation safety precautions. These continue to be distributed to more than 20,000 excavators and published on TSSA's Web site.

TSSA/Industry Partnerships

The Ontario Regional Common Ground Alliance (previously known as the Third Party Damage Committee), chaired by TSSA, comprises representatives from Ontario

utilities, contractors, major companies and industry associations. This group continues to address issues relating to pipeline safety and will focus on developing an overall prevention strategy, including targeted training and education programs for excavation contractors.

Detailed Causal Analysis of Pipeline Incidents

The Ontario Regional Common Ground Alliance is also involved in a project to identify the contributing factors behind inaccurate pipeline location procedures, failures in locating pipelines and improper excavations. The trend and causal analysis will assist TSSA in developing additional control mechanisms to minimize the occurrence of pipeline incidents.

Ensuring Safety Compliance

TSSA inspectors issue orders that legally require all fuels contractors including those working on natural gas pipelines to undertake specific actions based on the investigation of an incident. The number of legal orders issued to those found in non-compliance regarding pipeline incidents has risen by over 1,000% since 1997. The Administrative Penalties Program has also been introduced by TSSA to ensure full safety compliance for pipeline location and excavation. The new program allows TSSA to impose an immediate fine for safety non-compliance. TSSA also prosecutes in the most serious instances of unsafe activity.

PROPANE

HIGHLIGHTS

■ Incident Statistics

- > In 2002, TSSA investigated 37 propane incidents, and 45% of these were caused by human error.
- > There were four serious injuries and six fatalities, with all of the fatalities resulting from improper use of temporary heating devices.

■ TSSA Response

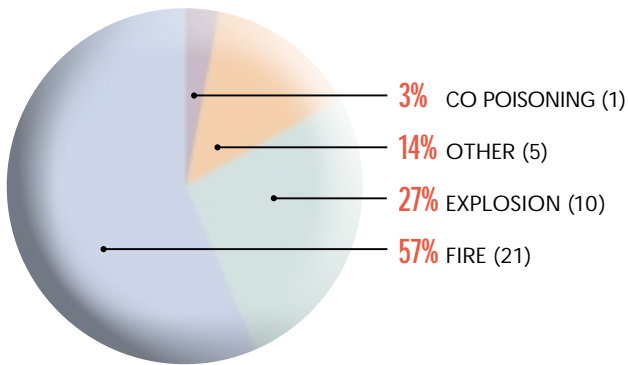
It is important that equipment users understand that there can be fatal consequences from the usage of outdoor propane equipment in an indoor or confined environment. TSSA and our industry partners will develop a new public education program on CO safety. Working with authorities in other provinces, we will also undertake a design and regulatory review of portable camp heaters.

BACKGROUND

Propane is stored as a liquid under pressure within cylinders and tanks. It is transported by road and rail and (in some cases) by pipeline. It is used for a variety of heating/refrigeration purposes as well as a fuel for automobiles, forklift trucks, generators, etc. Because it is transportable, propane is frequently the fuel of choice for recreational purposes. Propane represents approximately 10% of total fuel consumption for heating purposes. The storage, transportation and use of propane require a high degree of human interaction.

FIGURE 37

INVESTIGATED PROPANE INCIDENTS BY TYPE



Incidents

In 2002, TSSA received reports of 37 propane incidents. All of these were investigated by TSSA.

In 2002, 84% of propane incidents (31 out of 37) involved fires or explosions (57% and 27%, respectively). (See Figure 37)

The majority of propane incidents (78%) took place at the location where the fuel was being used for heating/refrigeration purposes. (See Figure 38)

Serious Injuries and Fatalities

Unfortunately in 2002, there were four serious injuries and six fatalities involving propane.

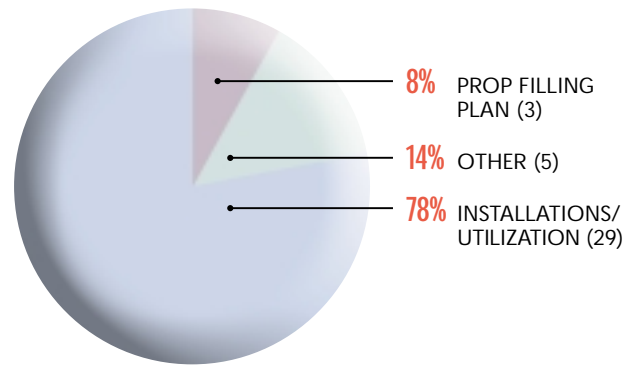
CAUSAL ANALYSIS (Figure 39)

Human error was a causal factor in 45% of all investigated propane incidents in 2002. Examples of human error included use of portable heaters in unventilated areas and poor maintenance of propane-fuelled refrigerators and space heaters.

The cause was not conclusively determined in 14 propane incidents (38%, 14 out of 37). In most of these

FIGURE 38

INVESTIGATED PROPANE INCIDENTS BY OPERATION TYPE



cases, full investigation was limited because critical evidence had been destroyed in the incident's fire or explosion.

All of the propane fatalities involved the indoor use of temporary heating devices designed for outdoor use. Two deaths resulted from a fire and an explosion, while four fatalities occurred in a single CO-poisoning incident.

TSSA RESPONSE (specific to propane)

Enhanced Public Education

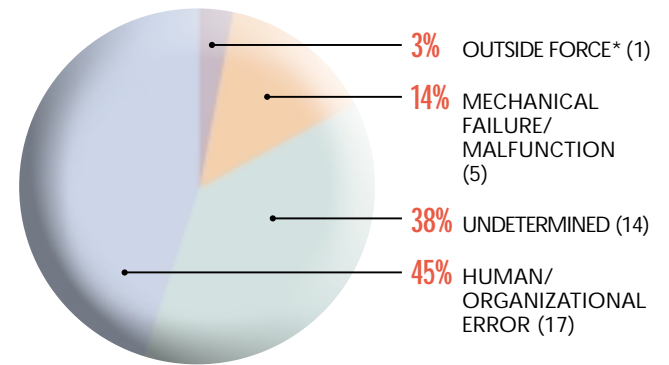
It is important that equipment users understand that there can be fatal consequences from the usage of outdoor propane equipment in an indoor or confined environment. TSSA will develop new strategies targeted at seasonal residents, campers, hunters and fishermen. These initiatives are designed to enhance awareness regarding the use of all portable fuel-fired appliances, including propane.

Equipment Design Review

In order to reduce or eliminate the risks associated with indoor usage of portable camp heaters, TSSA will work with authorities in other provinces to review designs and regulatory standards.

FIGURE 39

INVESTIGATED PROPANE INCIDENTS BY CAUSE



* Incident is caused by an external force, e.g., vehicle impact, mechanical impact, or natural hazard (lightning).

Increased Industry Communications

TSSA issued regular safety advisories to industry, including an Advisory on Cylinder Handling Facilities, Guidelines for Conducting Visual Inspection of Propane Installations, and an Advisory on Requirements on Approval of Propane Emergency Generators. These advisories were also posted on TSSA's web site.

Improved Design and Manufacturing of Fuels Appliances

TSSA continues to work with manufacturers of fuel appliances on improving their design and manufacture to prevent fires, explosions and CO exposure. This involves analyzing appliances to identify key design improvements and retrofits. For example, TSSA worked with manufacturers to replace a valve on a fuel appliance that was the cause of three separate propane explosions.

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