

ANNUAL PUBLIC SAFETY PERFORMANCE REPORT



For the Period May 1, 2011 to April 30, 2012
Technical Standards and Safety Authority



A Message from the President and CEO



We keep Ontarians safe, every hour of every day in virtually every aspect of daily life. From the drycleaners where we pick up our clothes, to the furnace that heats our homes, to the elevators we ride, to the buildings we learn and work in, we are there to protect all Ontario citizens. That's the mandate of the Technical Standards and Safety Authority (TSSA), an innovative, not-for-profit organization dedicated to public safety.

We administer and enforce public safety laws in Ontario under the *Technical Standards and Safety Act, 2000* (the Act) in seven designated industry sectors: amusement devices, boilers and pressure vessels, elevating devices, fuels, power plants, ski lifts, and upholstered and stuffed articles. The Ontario Ministry of Consumer Services (MCS) retains authority for the Act, and is responsible for setting public safety policy, overseeing delivery, and monitoring our performance.

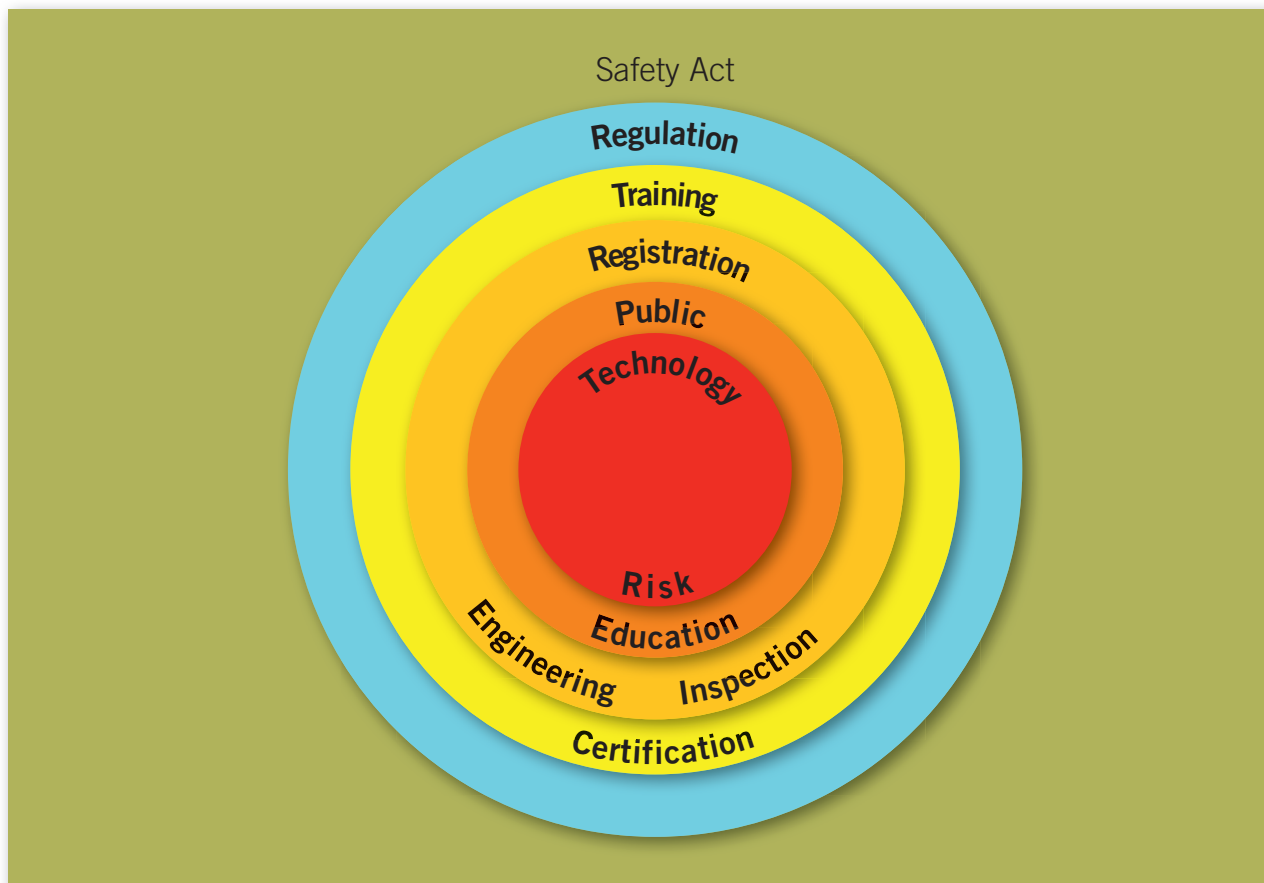
While our delegated powers are largely regulatory in nature, we embrace a much broader role and responsibility to achieve overall positive safety results. Although the cause of many incidents and injuries can be eliminated or constrained through regulations, codes, design, training, inspections and a variety of other means within our delegated authority, other causal factors, particularly those related to operator or user behaviour can at best only be influenced by us. Although we cannot control all the factors that influence safety outcomes, particularly where operator or user behaviour is involved, we strive to ensure the safety of Ontarians, acting as both a regulator and educator.

We have developed a Safety System[®], consisting of a number of interrelated components, to effectively eliminate or significantly mitigate technology-related risk. These components are:

- the *Technical Standards and Safety Act, 2000*, being our primary risk containment and control instrument;
- its regulations, which outline specific requirements to restrain risk, including the identification of persons having roles and responsibilities within the Safety System[®];
- training and certification to ensure that those persons are appropriately and adequately qualified to discharge their responsibilities;
- engineering review, registration and inspection activities to ensure that safety requirements are being applied and complied with for effective risk control;
- public education activities to increase awareness and enhance understanding of safety issues to ultimately result in safer behaviour; and
- the technology risk itself which, if the foregoing instruments are effectively applied, is restrained.

This approach to risk mitigation not only enhances safety outcomes and protects the health and well-being of Ontarians, it also creates economic benefits and financial savings.

Comprehensive TSSA Safety System® to Restrain Risk



Each of the components of our Safety System® contribute to enhancing safety for Ontarians. For example, by conducting regular inspections of the devices and facilities we regulate, we are able to confirm that they meet regulatory requirements or identify issues that need to be addressed. In those cases where a device does not meet all applicable requirements, we issue orders to bring the device into full compliance. Considering the diversity and complexities of the devices and facilities we regulate, the number and type of orders issued will vary across the various sectors. Our subsequent actions, depending on the level of safety risk, may include follow-up inspections or, in the rare instances of significant non-compliances, immediate shutdown of the device. Regardless, we follow-up on all orders issued to ensure that they are addressed and that the devices are brought into full compliance with the Act and regulations. Through this and other related actions associated with our safety services, we are able to effectively fulfil our public safety mandate.

At TSSA, we are excited about some of our recent initiatives to enhance public safety. The most notable contributor is the evolution of our innovative approach to risk management. Our safety and compliance strategies are guided by our application of risk-informed decision-making (RIDM) to ensure a systematic, scientific process, based on sound risk management principles, leading to a safer Ontario.

Fiscal year 2011/2012 is another year of significant accomplishments, particularly regarding the evolution of TSSA's safety measure, the Disability-Adjusted Life-Years (DALY) metric. Developed by the World Health Organization and adapted by TSSA, the DALY metric is a proven, international best practice approach to measuring and reporting health outcomes. In simple terms, a DALY of 1.0 is the loss of one year of healthy life of a single person due to an injury.

DALYs provide a rational and objective way of combining injuries of different severities into a single unit of measure. The metric provides a scientific basis for both reporting on health impacts and important decisions on public safety. DALYs enable us to quantitatively measure and externally benchmark health impacts, and focus our resources where the greatest potential exists to improve public health. As such, we report DALYs in three categories – based on our ability to influence safety:

- **non-compliance with regulatory requirements**, which indicates the impacts on health that result from someone who has responsibilities under the Act or regulations not complying with legal requirements;
- **potential inadequacy of the regulatory structure**, which indicates the impacts on health that result from a potential weakness in the regulations; and
- **factors external to the regulatory structure**, which indicates the impacts on health that result from situations where the public, using technologies that TSSA regulates, inadvertently puts themselves at risk through their own behaviour.

DALYs provide a numerical representation of all injuries over the reporting period, with consideration to three characteristics: severity, duration and frequency. For a specific injury, the DALY metric reflects the impact on the victim's quality of life, how long the effects last and whether the injury is permanent. DALYs are calculated from information that TSSA gathers through its activities and from other reliable sources. The burden of injury may be two-fold:

- **actual**, based on observed health impacts; and/or
- **predicted**, based on near-miss occurrences that did not result in an injury.

Both RIDM and DALY enhance our performance by helping us make informed decisions with respect to all the activities we undertake and services we deliver in the interest of public safety.

Throughout the year, we continued to support MCS and industry with completion of the first year of new regulatory changes for propane. We have been committed, active and engaged with MCS, industry and other key stakeholders to communicate the new requirements, and to assist with the implementation of risk and safety management plans (RSMPs) required under the new regulations. In fiscal year 2011/2012, we successfully worked with industry and launched a simplified RSMP renewal process for year two.

We made further progress in establishing regulatory strategies to manage ageing technology, establishing risk-informed decisions for aboveground fuel oil storage tanks and elevator over-speed conditions. TSSA also led a national initiative in partnership with the Canadian Standards Association for the development of a public risk management standard – a very exciting, ongoing initiative. A new risk-informed inspection order policy is underway, which will standardize the way in which we apply RIDM principles in making key regulatory decisions. This will also improve the quality of information used for a variety of decision-making purposes. Seeking to further enhance our data analysis, we developed a Quality Management System for safety performance measurement and reporting, gearing towards ISO 9000 certification in the near future.

In the elevating devices sector, we continued to implement key enforcement initiatives to achieve positive compliance trends, including cost-effective, voluntary reporting for low-risk non-compliance, a zero tolerance policy for overdue safety tests resulting in elevator shutdowns and the implementation of financial deterrents for non-compliance. We continued to work collaboratively with contractors in the fuels sector through the pre-registration process to ensure better understanding of code and regulatory

requirements, including a comprehensive guide book for TSSA safety audits. In the boilers and pressure vessels sector, we continued to consult with industry on new requirements for inspecting the inside of pressure equipment, a shared database for inspection reporting with boiler insurers, and more effective communication regarding code changes.

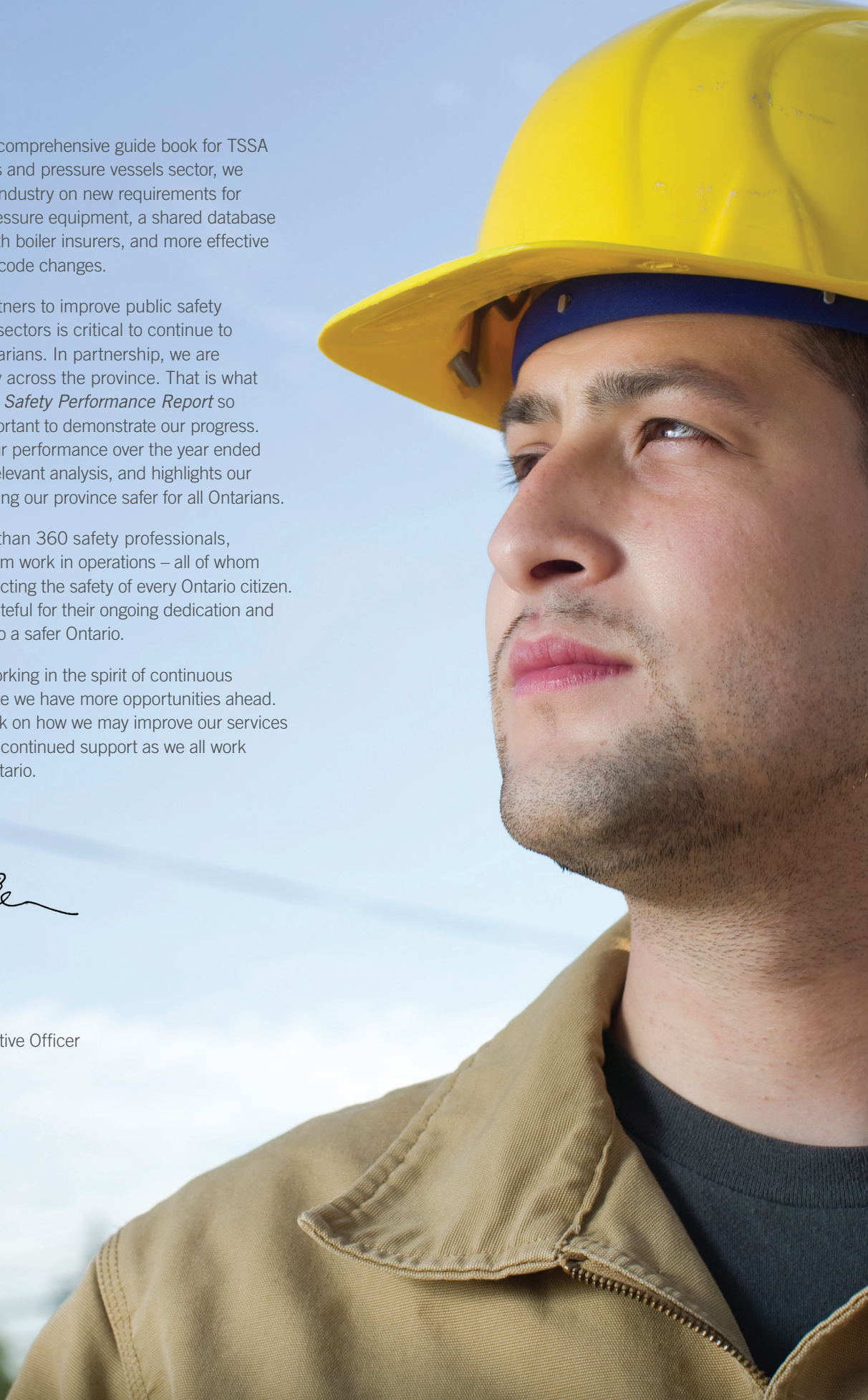
Working with industry partners to improve public safety throughout our regulated sectors is critical to continue to enhance safety for all Ontarians. In partnership, we are championing public safety across the province. That is what makes this *Annual Public Safety Performance Report* so critical – and why it is important to demonstrate our progress. This report summarizes our performance over the year ended April 30, 2012, provides relevant analysis, and highlights our achievements toward making our province safer for all Ontarians.

We have a team of more than 360 safety professionals, approximately 75% of whom work in operations – all of whom are passionate about protecting the safety of every Ontario citizen. I am very proud of and grateful for their ongoing dedication and meaningful contributions to a safer Ontario.

At TSSA, we are always working in the spirit of continuous improvement. We recognize we have more opportunities ahead. We welcome your feedback on how we may improve our services and we thank you for your continued support as we all work together toward a safer Ontario.



Kathy Milsom, P.Eng.
President and Chief Executive Officer



Preface

The *Annual Public Safety Performance Report* is published by the Technical Standards and Safety Authority (TSSA) to provide readers with an overview of the state of public safety and compliance in the areas it oversees. It is based on the information collected through its safety activities. The *Annual Public Safety Performance Report* contains enhanced reporting, information on historic trends and TSSA actions taken to continually improve compliance and manage public safety issues.

The *Annual Public Safety Performance Report* is structured into two primary sections:

- Executive Summary; and
- Analysis on State of Public Safety and Compliance, which is structured consistently across all the public safety sectors regulated by TSSA.

Executive Summary

This section of the report contains two sub-sections:

- Message from the Chief Advisor, Public Safety Risk Management; and
- Messages from the Statutory Directors.

The message from the Chief Advisor, Public Safety Risk Management provides highlights of the results of the analysis carried out during TSSA activities involving inspections, audits, and occurrence inspections. In particular, this sub-section provides the current view of the state of public safety and state of compliance and in TSSA's regulated sectors based on TSSA observations, observed trends based on historic information and the expected risks in the future. This sub-section highlights the areas of concern and opportunities to assist TSSA statutory directors in establishing public safety and compliance strategies.

The second sub-section contains messages from the statutory directors describing TSSA actions that have been implemented or are being planned in response to the results of public safety analysis. In particular, this sub-section highlights the responses provided by the statutory directors to the areas of concern and opportunities identified by the Chief Advisor, Public Safety Risk Management. In addition, the statutory directors also capture significant compliance and safety strategies which have been established to address identified safety issues and to proactively reduce public safety risk to Ontarians.

Analysis on State of Public Safety and Compliance

This section provides the readership with an overview of the activities undertaken by TSSA from May 1, 2011 to April 30, 2012 specific to inspecting occurrences, and periodic inspections and audits across the various regulated technologies and tradespersons. This overview includes measurement indicators and metrics that illustrate the body of work that TSSA has carried out in the province to proactively manage compliance and determine the causes of any incidents or failures that could have led to or have had health impacts on the public.

This section also provides the results of analysis on trends and outcomes of these activities. The analysis gives readers a perspective on the state of compliance and the associated state of safety over a continuous period of time and is based on information available to TSSA. Specific indicators and metrics allowing readers to understand and evaluate the outcomes of TSSA activities are included.

The information used to generate a trend for each indicator is also used to determine expected values for the next fiscal year (2012/2013), through the use of a prediction interval. Additional details related to prediction intervals are provided in Appendix A. On a quarterly basis, the indicators will be compared against their prediction interval to determine if they follow the behaviour of historical observations.

This section continues to report on observed health impacts resulting from incidents that have occurred during the measured period using the Disability-Adjusted Life Years (DALY) metric that TSSA introduced in last year's report as an aggregate and by the causal analysis categories as described in Appendix B. Over the past three years, TSSA has developed and tested an innovative approach to measuring safety performance based on international best practices. Designed by the World Health Organization (WHO) and adapted by TSSA, the DALY metric quantifies the burden of injury, which is defined as the cumulative health impact on an exposed population. A DALY of 1.0 is the loss of one year of healthy life of a single person due to an injury.

During the course of the last fiscal year, TSSA has evolved the DALY metric to a predictive measure. Based on incident history and accounting for variability and uncertainties associated with them, TSSA is now able to predict the expected injury burden during the course of the next fiscal year (expressed as Predicted DALYs/million people/year). More details regarding this metric, its calculation and its applicability are provided in Appendix C. Additionally, TSSA will convert this estimate into a fatality-equivalent, defined in Appendix D, to be able to compare with an internationally adopted risk acceptability criteria of 1 fatality in a million people per year¹. This comparison will provide TSSA an opportunity to characterize the level of risk that Ontarians are currently exposed to in its regulated sectors, as well as to enable TSSA to compare against international benchmarks.

In addition to reporting on predicted DALYs and predicted fatality-equivalents, TSSA will continue reporting on observed fatalities and injuries. Commencing with this year's report, TSSA will further characterise injuries into permanent and non-permanent injuries based on the nature of the health impact (determined by the use of DALYs). Definitions for permanent and non-permanent injuries have been included in Appendix D.

¹ University of British Columbia (2011), Risk Acceptability Criteria for effective regulation of technological risks, technical report submitted by Faculty of Applied Science, School of Engineering for Technical Standards and Safety Authority (TSSA).

Note to Reader on Interpretation of Analysis on State of Public Safety and Compliance

Characterization of Trends

Charts depicting trends in the public safety analysis sections include actual data points based on quarterly observations during the last five to eight fiscal years and show a smoothed local curve of best fit that is statistically determined.

Statistical analysis was conducted on the actual data points to determine the existence of trends that show the tendency of the data over the entire time period considered. If the statistical analysis revealed insufficient evidence to support the existence of a trend, statements have been made accordingly. Additional commentary has been provided on localized changes in patterns stemming from the curve of best fit where appropriate.

The reader is cautioned that the results of the statistical trend analysis may not appear consistent with the perceived visual appearance of the curve of best fit. The smooth curve primarily aids assessment of the linearity of the data and indicates any localized changes in pattern. In order to obtain a comprehensive understanding of the behaviour of data over the entirety of the measured period, relevant statistical tests were conducted to establish the nature of the trends.

It is also possible that the presented curves of best fit can highlight local trends that may not be reflected in the long-term statistical trend tests. The reader is cautioned that the statistical trends are global in nature; they are based on a longer period and analyze the behaviour of the data as a whole. Trend tests on smaller time frames have been conducted where relevant; such results are presented and contextualized with respect to recent actions and/or decisions.

Historical trends with respect to occurrences and their associated health impacts do not consider the exposed population as TSSA may not have accurate information in this respect. This is particularly relevant in safety programs where TSSA does not specifically license and/or inspect devices, such as home heating appliances; however, the reader is provided with a broad understanding of the population of devices that are regulated to give a perspective on the significance of trends with respect to health impacts.

Assumptions and Sources of Uncertainty

It is important for the reader to note that, while in general, analysis on trends will be provided over a ten-year period, the trends in this report are based on shorter time periods due to ongoing improvements in data gathering and analysis systems. The historic database was not designed and maintained consistently across all programs to be compatible with current improved systems. This restricted the ability to consolidate information from the entire ten-year time period. For compliance information, the time period begins May 1, 2004. For safety information, the time period starts May 1, 2007, except where noted.

In producing this report, TSSA makes every effort to ensure a high level of data integrity and continuously works toward improving the integrity of all data collected for the purposes of reporting. TSSA uses a rigorous quality assurance procedure to ensure that the analysis results are accurate and reflective of the observations of its inspections and engineering activities. Although TSSA strives to achieve high levels of data integrity at all times, it is sometimes necessary to make restatements to results reported in previous fiscal years. These variances are typically a result of time-frame factors such as information received subsequent to the issuance of the report, localized reporting lags for periodic data and other issues. All such restatements are noted and, in the event of a material restatement, a thorough explanation is provided.

Analysis involving reported and inspected occurrences may be significantly impacted by reporting biases, defined in Appendix D. Due to the varied nature of reporting across the different regulated sectors, TSSA is currently unable to quantify the level of reporting bias and is therefore not currently in a position to account for this uncertainty.

Analysis involving prediction of health impacts and those conducted as part of safety risk assessments recorded in this report have identified and quantitatively accounted for additional sources of uncertainties. Explicitly stated predictions in this report typically represent expected values after accounting for such known sources of uncertainties.

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Executive Summary

Message from the Chief Advisor, Public Safety Risk Management

TSSA introduced a risk-informed decision-making (RIDM) framework in fiscal year 2005/2006 as an objective, fact- and evidence-based process to ascertain risks to Ontarians resulting from the direct or indirect exposure to technologies, products, and infrastructure that it regulates. This is intended to provide a basis for management of the significant risk sources through a transparent and effective administration of the *Technical Standards and Safety Act, 2000* (the Act) and associated regulations. This report acts as a primary source of knowledge on risk to Ontarians, its sources and possible areas of concern. The development of the report also provides the regulatory decision makers across the various safety programs a forum to express the current and future safety strategies that they have established with the ultimate goal of enhancing the safety of Ontarians.

The knowledge on risk is determined primarily through three sources of information:

- TSSA conducted inspections and audits which provide valuable information on the state of compliance;
- TSSA inspected incident and near miss occurrences which provide information on cause and consequences; and
- other valid and reliable sources of information which help ascertain a broader understanding of risks.

Gathering knowledge on the state of compliance provides insight into potential safety risks that may manifest in the future. Observation of the levels of compliance through TSSA inspections and audits has two functions. It primarily mitigates the manifestation of potential safety risks; additionally, it provides valuable information on the nature and extent of compliance issues related to these safety risks.

Incident and near-miss occurrences are the ultimate realization of safety risks and can result from any one of three causal categories, defined in Appendix B:

- Category 1 – Causal factors related to potential inadequacies in the regulatory system;
- Category 2 – Causal factors related to non-compliance with the current regulatory system; or
- Category 3 – Causal factors not within the purview of current regulatory system.

The significance of occurrences that may have or have the potential to cause health impacts to Ontarians and represented as expected health impact or injury burden are better understood by the use of a metric known as the Disability-Adjusted Life Year (DALY). A detailed description of the methodology used to calculate DALYs is provided in Appendix C. For the purposes of this section, one DALY may be better understood as the loss of one year of healthy life resulting from an injury.

This section of the executive summary serves three purposes. The first is to give insight into key findings of the analysis on the state of public safety and compliance outcomes aggregated across all safety programs. The second is to present important program-specific observations to each TSSA director having statutory responsibilities (Statutory Director) for their consideration when establishing their public safety strategy. The third purpose is to identify areas for complementing TSSA's RIDM initiatives based on a proactive assessment of risks and/or to report on current RIDM initiatives all of which would result in continued enhancement to public safety.

Report on Overall State of Public Safety and Compliance

Analysis on Overall State of Public Safety (Represented by Expected Health Impact or Injury Burden on Ontarians)

During the last fiscal year, 2,859 incident and near-miss occurrence inspections were conducted and found to be under TSSA's jurisdiction. The aggregate DALYs² resulting from these incidents with health impacts was observed to be approximately 218.18. Assuming that the entire population of Ontario³ is exposed to one or more of these technologies, this translates to approximately 16.78 DALYs in one million Ontarians, or the equivalent of 0.38 fatalities in a million people (assuming 44 DALYs is the estimated equivalent of one fatality⁴). Accounting for uncertainties associated with exposure, injury severity, age variability and near-misses and based on the above mentioned occurrence rate, 40.1 DALYs per million people per year is the mean predicted risk.⁵ This translates into 0.9 fatality-equivalents per million people per year. Key points of interest include:

- There is a decreasing trend in the overall number of occurrences⁶ per quarter since fiscal year 2007/2008⁷. Additionally, the number of occurrences with causal factors related to potential inadequacies in the regulatory system and non-compliance with the current regulatory system demonstrate decreasing trends, while the number of occurrences with causal factors not within the purview of the current regulatory system demonstrates an increasing trend during the same period.
- There is a decreasing trend in the number of permanent injuries each quarter since the first quarter of fiscal year 2007/2008.
- While the aggregate health impacts, represented as DALYs per quarter, do not demonstrate a trend over the last five fiscal years, health impacts resulting from causal factors related to potential inadequacies in the regulatory system and non-compliance with the current regulatory system demonstrate decreasing trends.
- Risks due to carbon monoxide exposures resulting from fuel-burning appliances is the most significant contributor to the overall level of risks to Ontarians. In particular, appliances located at residences (including private and multi-residential dwellings), institutions with sensitive sub-populations (including schools, hospitals etc.) are most likely to contribute to the risks due to carbon monoxide exposures.
- Risks associated with carbon monoxide exposures in homes are a global phenomenon especially in countries with colder temperatures. The consumer working group on product safety (COPOLCO) at the International Standardization Organization (ISO) is concerned with carbon monoxide emissions from products, such as barbecues and heaters, used in small, confined spaces with poor ventilation and is contemplating actions including the possibility of creating guidance for consumer use of appliances. It is currently involved in collecting incident data from around the world to better inform its next course of action and TSSA is assisting in this initiative. Independently, the Global Burden of Disease and Injury study carried out by the Institute of Population Health Metrics and Evaluation plans to report on the overall injury burden due to this cause in its forthcoming report later this year.
- The injury burden posed by elevating and amusement devices are well within the risk acceptability criteria; however, the risks resulting from factors external to the regulatory system (such as user behaviour) continue to be a dominant contributor to the overall level of risks. This is important in particular with elevators, as an increasing trend is being observed with respect to occurrences due to such factors.

² Calculation based on a deterministic analysis that does not account for the uncertainties associated with the exposure variability, injury severity, age variability, and reporting bias.

³ Assumed to be 13 million (Ontario Ministry of Finance 2011)

⁴ Based on the standard life expectancy of Ontarians using published data from the Ministry of Finance (2011), the mean DALY value for a fatality is estimated to be approximately 44 DALYs.

⁵ Based on the 50th percentile of a simulated frequency distribution representing the mean value.

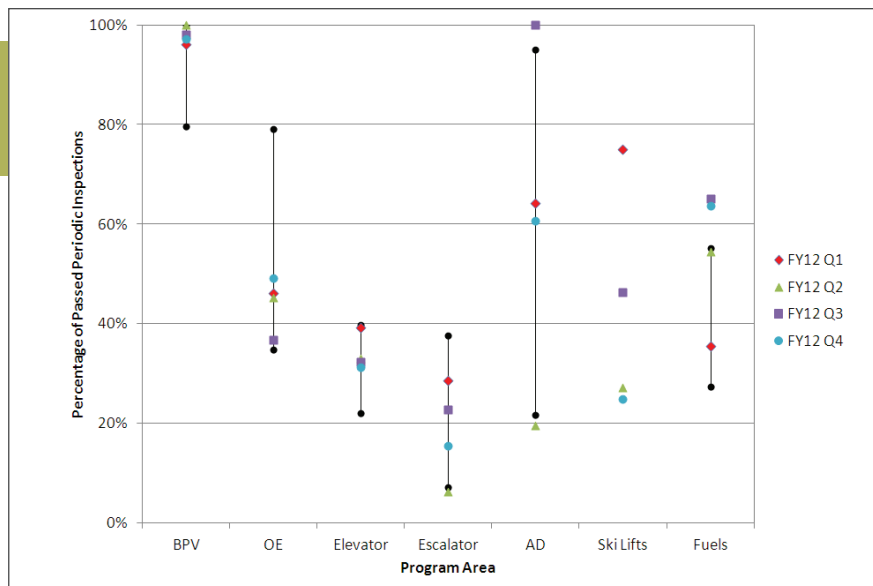
⁶ Pipeline strikes are excluded from this analysis.

⁷ This is the first quarter the incident management system was in use for all programs.

Analysis on Overall State of Compliance

TSSA gathers information on the state of compliance of technologies, devices, infrastructure and regulated trades through a combination of periodic and random inspections and audits. The nature and level of effort varies across different safety programs and is sometimes dependent on the scope defined in the program-specific regulations. The pass rate of such inspections can be considered a good indicator of the overall state of compliance. More importantly, comparing this indicator against historic observations allows one to gain an understanding of the state of compliance over time. The historic observations are characterized by the use of metrics known as prediction intervals⁸ which provide the expected values with a certain degree of confidence. Figure 1 below indicates the observed values for the four quarters of the last fiscal year across the different programs in comparison with their respective prediction intervals estimated at the beginning of the period. Sections in this report related to each of the safety programs contain prediction intervals estimated for the next fiscal year 2012/2013.

Figure 1: The percentage of passed periodic inspections compared to its prediction interval for each program



Key observations associated with analysis of compliance findings across all relevant safety programs include:

- With respect to elevating and amusement devices and power plants managed by operating engineers, no significant changes (>5%)⁹ have occurred in either the lower or upper bounds of the prediction intervals for the current fiscal year (2012/2013) as compared to the last fiscal year shown in Figure 1 above. This indicates no significant change in the overall state of compliance and/or in the variability of observations, as indicated by the upper and lower bound values.
- The upper bound of the prediction interval for passed periodic inspections at fuels storage and dispensing sites increased by nearly 9% as compared to the last fiscal year. As indicated in the body of the report, an increasing compliance trend is also observed at these locations

⁸ The prediction intervals for the elevating devices, amusement devices, power plants with operating engineers, and fuels safety programs are applicable to licensed devices and facilities and are expected to cover a statistically significant fraction of the inventory over the measured period. The prediction intervals for the boilers and pressure vessels only represent the uninsured inventory. Due to limited data, prediction intervals for the Upholstered and Stuffed Articles program are not available.

⁹ TSSA indicator for determining significant changes in prediction intervals.

- Devices in the elevating devices program that were not inspected in over three years were observed to have high levels of non-compliance and evidence continues to suggest that devices not inspected within a three-year period may lead to a possible occurrence.
- A better understanding of the size of the inventory for boilers and pressure vessels (uninsured and insured) along with compliance information on the insured vessels will assist in characterizing the overall state of compliance in that sector.
- Compliance information collected over a longer time period combined with knowledge of the size of the inventory of retailers, importers and distributors would provide a more informed basis for characterizing the state of compliance of upholstered and stuffed articles sold to consumers in the province.

Program-specific Highlights of Compliance and Safety Outcomes

Boilers and Pressure Vessels (BPV)

TSSA inspects uninsured boilers and pressure vessels in the province in accordance with the requirements of the regulation. Uninsured devices are believed to represent less than 10% of all equipment currently in use in the province. Trends observed based on TSSA periodic inspections may not provide a reflection of the general state of compliance across all pieces of equipment in the province.

Safety Outcomes – Key Findings

1. There were three occurrences reported in fiscal year 2011/2012, and their occurrence inspections are currently in progress. No health impacts were reported for these occurrences.

Compliance Outcomes – Key Findings

1. Of the 358 periodic inspections conducted on uninsured equipment during the last fiscal year, 97.21% were compliant with regulations on first visit. No demonstrable trends are observed during the course of the last eight fiscal years.

Observations for Consideration

- BPV-1: In order to gain a relevant representation of the state of compliance across the boilers and pressure vessels program, it is essential to obtain an understanding of the level of compliance observed with insured equipment that forms the bulk of the provincial inventory. In particular, levels and reasons for non-compliance and associated trends across the whole inventory will better assist in establishing compliance strategy, if necessary.
- BPV-2: Reporting on near-misses, if any, will also provide useful information for analyzing and characterizing risks in this sector. In this regard, the effectiveness of the recently incorporated reporting guidelines¹⁰ may be evaluated.

Operating Engineers (OE)

TSSA conducts periodic inspections on nearly 2,900 registered plants with operating engineers in the province of Ontario.

Safety Outcomes – Key Findings

There were two incidents reported in fiscal year 2011/2012. The first occurred in a children's daycare centre and was reported to have occurred due to overheating of a boiler. The root cause was identified as being due to a lack of maintenance procedures required under the *Operating Engineers Regulation*. The second occurrence took place in a refrigeration plant, and was reported to have occurred due to the breakage of sight glass, which resulted in ammonia release. The root cause was identified as being due to defective or inadequate installation procedures. No health impacts were associated with either occurrence.

¹⁰ The reporting guidelines list the requirements for owners of boilers and pressure vessels to report to TSSA any incidents involving the equipment. The guidelines can be found on the web at <http://www.tssa.org/regulated/boilers/inspections/boilersInspections09.asp>.

Compliance Outcomes – Key Findings

1. Of the 2,721 inspections completed during the last fiscal year, 43.88% were found to be compliant with the regulations during the first visit, a drop from 48.14% observed the year before. There continues to be a decreasing trend observed over the last eight fiscal years with respect to this inspection outcome and an increasing trend in the number of inspections requiring follow-up due to observed non-compliances.
2. Analysis of inspections conducted at institutional locations (schools, hospitals and community centres), indicates a decreasing trend in compliance.

Observations for Consideration

- OE-1: TSSA's continued evolution of a risk-informed inspection process should assist in focusing more on the plants contributing to increasing rates of non-compliance. In particular, further analysis to assess reasons for the increasing non-compliance trends at institutional locations will assist in determining appropriate compliance management strategies.

Amusement Devices (AD)

TSSA conducts inspections on all amusement devices prior to their use each year. The result of these inspections are documented and subsequently analyzed when measuring compliance indicators.

Safety Outcomes – Key Findings

1. There were 227 reported occurrences on amusement devices during fiscal year 2011/2012. Occurrence inspections were conducted on 104 occurrences during fiscal year 2011/2012, resulting in an aggregate health impact of 0.1992 DALYs. 99.6% of these DALYs resulted from factors external to the current regulatory system (typically attributed to users 'failing to follow user instructions').
2. There continues to be a decreasing trend in the number of occurrences resulting from non-compliance with the regulatory system since fiscal year 2007/2008. This decreasing trend is also observed in the DALYs resulting from the same causal category.
3. Analysis of occurrences over the last five years indicates that the mean predicted risk of health impact while riding an amusement device is 4.7 DALYs per million people per year or 0.1 fatality-equivalents per million people per year which is significantly lower than the risk acceptability criteria.
4. Go-kart use poses the most significant risk, while water slides would account for the most expected occurrences.
5. Occurrences due to non-compliance with the regulatory system tend to contribute to the risks on rides other than go-karts and water slides.

Compliance Outcomes – Key Findings

1. No major non-compliance findings were observed based on the analysis of information collected during the last fiscal year.
2. No demonstrable trend has been observed over the last eight fiscal years with respect to the quarterly rate of inspections compliant with regulations on first visit or being shut down. There is a decreasing trend in the rate of inspections requiring follow-up due to observed non-compliances.

Observations for Consideration

- AD-1: Further analysis with respect to occurrences caused by factors external to the current regulatory system may be carried out to establish appropriate regulatory or other proactive safety improvement strategies, particularly with respect to the usage of go-karts and waterslides. An evaluation and possible improvements to the occurrence inspection process, to better understand and capture information on user behaviour through enhanced root cause analysis tools, may help determine appropriate risk mitigation strategies.
- AD-2: Further analysis of occurrences due to non-compliances on other rides may help ascertain if device ageing is a contributing factor to occurrences.

Elevating Devices (ED)

TSSA has administrative powers and is required to inspect all elevating devices in the province, inclusive of elevators, escalators and moving walks and passenger ropeways and ski lifts, at such frequencies determined to be adequate by the Statutory Director. The results of these inspections are documented and subsequently analyzed when measuring compliance indicators.

Safety Outcomes – Key Findings

1. There were 324 reported occurrences on elevators and 499 reported occurrences on escalators during the fiscal year 2011/2012. Occurrence inspections were conducted for 720 occurrences accounting for an aggregate health impact of 121.7 DALYs.
2. There were 121 reported occurrences on passenger ropeways and ski lifts during the fiscal year 2011/2012. Occurrence inspections were conducted for 86 occurrences resulting in 0.14 DALYs. All of these DALYs resulted from factors external to the current regulatory system (typically attributed to users ‘failing to follow user instructions’).
3. Two unfortunate occurrences resulted in fatalities during the course of the last fiscal year. One involved an elevator mechanic who was working on the elevator and as such falls under the jurisdiction of the Ministry of Labour. The other resulted when an elderly victim fell after being struck in the back of the foot by the elevator door when exiting the elevator. Additionally, 15 permanent injuries resulted during the same period, of which three are pending an occurrence inspection.
4. There is a decreasing trend in the number of occurrences on elevators and escalators caused by non-compliance with the regulatory system. There is an increasing trend in the number of occurrences on elevators caused by factors external to the current regulatory system, with ‘failure to follow user instructions’ being the dominant cause.
5. Analysis of occurrences over the last five years indicates that the mean predicted risk of health impact while riding an elevator is 31.4 DALYs per million people per year or 0.7 fatality-equivalents per million people per year which is within the risk acceptability criteria. The estimated risk is primarily due to factors external to the regulatory system. Nearly 23% of predicted health impacts in the future are expected to result from non-compliance to regulations.
6. The mean predicted risk of health impact while riding escalators and ski lifts are 7 DALYs (0.2 fatality-equivalents), per million people per year, and 1.3 DALYs (0.03 fatality-equivalents), per million people per year respectively and well within the risk acceptability criteria.

Compliance Outcomes – Key Findings

1. Of the 19,780 periodic inspections conducted by TSSA during the last fiscal year on elevators, 33.67% found the device to be compliant with regulations during the first visit. An increasing trend continues to be observed in the number of elevators compliant with regulations on first visit per quarter when estimated over the last eight fiscal years. 821 periodic inspections were conducted during the last fiscal year on escalators with 18.64% of them passing on first visit.
2. Nearly 73% of inspections conducted on devices that were not inspected in the three years preceding the last fiscal year resulted in non-compliances being found and orders issued by TSSA inspectors.
3. An analysis of periodic inspections of elevators, escalators and moving walks since fiscal year 2004/2005 indicates that an average of 1.6 follow-up inspections is conducted on devices that fail on first visit. These follow-up inspections are conducted to ensure the resolution of non-compliances found during periodic inspections.

Observations for Consideration

- ED-1: While occurrences due to non-compliance with regulations demonstrate a decreasing trend, it is expected that nearly 25% of health impacts in the future are expected to result from this root cause. Factors such as ageing technology may be assessed further to determine their impact on this aspect of the risk profile.
- ED-2: Factors external to the current regulatory system contribute the most to reported occurrences and corresponding health impacts. Typical causes involve user behaviour and related issues.
- ED-3: Appropriate compliance strategies to address non-compliances found in over 60% of elevator and 80% of escalator inspections during the course of the fiscal year 2011/2012 may be determined by gaining a better understanding of the nature and significance of non-compliances. This will also enable focusing TSSA's inspection resources on those devices posing significant risks to Ontarians.

Fuels (FS)

TSSA conducts periodic inspections of licensed facilities storing and dispensing fuels, which includes annual inspections of facilities storing and dispensing propane. In addition to these licensed site inspections, TSSA conducts audits of contractors who install and maintain fuel-burning devices such as heating appliances in residential homes. The periodic inspection and audit compliance results presented in this document are limited to these activities.

Safety Outcomes – Key Findings

1. 1,139 occurrences (not involving pipeline strikes¹¹), were reported and found to be within TSSA jurisdiction during the last fiscal year. There continues to be a decreasing trend in the number of occurrences reported since the third quarter of the fiscal year 2006/2007.
2. Carbon monoxide releases (24.50%), leaks (19.67%), vapour releases (18.88%), and fires (16.07%) were the most prevalent type of occurrences during the last fiscal year.
3. 90.41% of all inspected occurrences transpired during the utilization of fuels¹², while 1.92% of these occurrences transpired during transmission, distribution and/or transportation of fuels. Occurrences transpiring during the utilization of fuels continue to demonstrate an increasing trend since the third quarter of fiscal year 2006/2007.
4. Nearly 80% of all completed occurrence inspections resulted from non-compliance with regulations during the last fiscal year. Analysis over the last five years indicates that all three causal categories demonstrate a decreasing trend.

¹¹ Pipeline Strikes where no consequences have occurred are documented and analyzed separately; however, pipeline strikes where consequences such as vapour releases etc., are considered in this estimate.

¹² TSSA has jurisdiction over three phases of the fuels lifecycle: transmission, distribution and transportation, storage and dispensing, and utilization.

5. Nearly 61% of the 1,472 pipeline strikes inspected by TSSA were due to improper excavation practices.
6. Two fatalities, eight permanent injuries and 21 non-permanent injuries resulted from inspected occurrences during the last fiscal year with an aggregate health impact of 96.11 DALYs. The permanent injuries demonstrate a decreasing trend since fiscal year 2006/2007.
7. Analysis of occurrences over the last five years indicate that the mean predicted risk of health impacts resulting across all fuels life cycle stages is 51.7 DALYs (1.2 fatality-equivalents), per million people per year, which is higher than the risk acceptability criteria. Risk due to carbon monoxide exposures resulting from fuel-burning appliances (utilization stage of the fuels life cycle) is the leading contributor to the overall level of risk.
8. Risks resulting from fuel-burning appliances at institutional locations with sensitive sub-populations (e.g., schools, hospitals, nursing homes, long-term care facilities, etc.) and at residences (private dwelling and multi-unit residential) are identified to be the most significant and are expected to occur primarily due to non-compliance with the regulations.

Compliance Outcomes – Key Findings

1. Of the 3,102 periodic inspections conducted at fuels licensed sites during the last fiscal year, 56.16% were found to be compliant with regulations on first visit. An increasing trend continues to be observed in the number of such sites compliant with regulations on first visit over the last eight fiscal years. Correspondingly, the number of licensed sites requiring a follow-up inspection due to observed non-compliance also continues to show a decreasing trend during the same eight-year period.
2. Periodic inspections at facilities storing and dispensing propane demonstrate an increasing compliance trend.
3. Of the 2,013 contractor audits conducted, 72.73% were found to be compliant with regulations on first visit. A decreasing trend is noted with respect to audits requiring follow-up due to observed non-compliances.

Observations for Consideration

- FS-1: Public health impact risks at locations where fuel is utilized for heating purposes continues to show an increasing trend. In particular, risks at institutions and residences (including private dwelling and multi-unit residential) are expected to continue to be significant contributors.
- FS-2: The lack of maintenance of fuel-burning equipment at institutions and residences is the leading cause of occurrences leading to health impacts.
- FS-3: Since the introduction of annual inspection requirements at propane storage and dispensing facilities, there is a demonstrable increase in compliance trends.

Upholstered and Stuffed Articles (USA)

Compliance Outcomes – Key Findings

1. Of the 1,177 inspections conducted during various stages of the upholstered and stuffed article life cycle during the last fiscal year, 70.86% of these yielded a compliant result which includes resolution of observed infractions. The majority of these inspections were conducted at retail sites, which can be considered to be the final point of direct contact with the consumer.
2. The majority of inspection orders were issued at retail sites, although no significant trends were observed for orders issued at these sites. The number of inspection orders issued per inspection during the importer/distributor life cycle stage demonstrates an increasing trend over the last three years.
3. Of the 8,816 inspection orders that were issued last fiscal year, 2,905 of these were related to non-registered manufacturers.
4. The three article types that were issued the most orders last fiscal year were furniture, clothing and medical items.

Observations for Consideration

- USA-1: Further clarification of specific infraction types found during inspections would assist in public safety strategy.

Risk-Informed Decision-Making (RIDM) Initiatives

TSSA's RIDM framework assists in enhancing and continually improving TSSA's public safety management decision process. RIDM aids the statutory directors of each safety program in evaluating the current regulatory framework, identifying gaps and developing potential solutions for managing public safety risks through the use of formal risk assessment methods that are based on international best practices. In this regard, several RIDM initiatives are currently underway. Two major initiatives demonstrating TSSA's ongoing application of RIDM are described below.

Risk-Informed Management of Ageing Technology and Infrastructure

As technologies, infrastructure, and devices under TSSA's jurisdiction reach the end of their defined or perceived service lives, the potential for age-induced failures tends to increase due to a variety of reasons, including the environment in which they operate, wear and tear, fatigue, and becoming technologically obsolete. In response to age-related incidents in the past and to proactively manage age-induced health risks associated with the various technologies, TSSA has been working on pilot projects in several safety programs over the past couple of years. TSSA will establish a formal risk-informed ageing technology management strategy based on the results of these pilot studies. Projects currently underway include the following:

- assessment of age-induced risks and establishment of service lives for single-walled, above-ground storage tanks that are used for storing fuel oil in residential locations;
- characterization and evaluation of risks associated with over-speed conditions of elevators designed to older codes and standards;
- development of feasibility studies evaluating the need to mandate internal inspections of boilers and vessels due to potential risks associated with age-induced internal failures; and
- review and identification of opportunities to enhance risk assessment requirements used to manage pipeline failures due to ageing.

Results and current status of these studies and TSSA's strategic courses of action are included in the relevant sections of the report.

Risk-Informed Periodic Inspection Scheduling and Enforcement

In line with international risk management best practices and as part of TSSA's continual improvement of its decision-making framework, TSSA has enhanced the concept of its risk-informed inspection scheduling and enforcement model. The initial design phase of the model is currently underway involving the standardization and risk characterization of inspection orders which will provide key input into the model. Risk characterization of observed non-compliances will define allowable compliance times and guide enforcement decisions.

Recommended RIDM Initiatives for Consideration – Management of Risks at Institutions with Sensitive Sub-Populations

Institutions with sensitive sub-populations include schools, hospitals, nursing homes, long-term care facilities, community centres and seniors residences. These locations house Ontario's vulnerable populations who may be involuntarily exposed to risks. Typically the risk acceptability criteria are an order of magnitude lower than other locations. For example, the Major Industrial Accidents Council of Canada recommends risk acceptability criteria of 1 fatality in 10 million people per year.

An analysis of occurrences involving TSSA-regulated technologies and products¹³ at these locations estimates the mean predicted risk to be approximately 56 DALYs per million people per year or 1.3 fatality-equivalents per million people per year. This is greater than the recommended risk acceptability criteria. The most significant contributor to this risk is due to poor maintenance of fuel-burning appliances followed by user behavioural factors resulting in elevator incidents. Two occurrences also took place at schools during the last fiscal year involving boilers which fortunately did not result in any injuries. Additionally, analysis of periodic inspections conducted at locations for elevating devices and operating plants demonstrate an increasing trend in shutdowns. Inspection outcomes involving operating plants additionally show a decreasing trend in inspections passing on first visit.

Messages from the Statutory Directors

Introduction

The *Annual Public Safety Performance Report* is a valuable tool for the statutory directors as it provides information collected through safety activities in each program area. This information assists the directors in appropriately allocating resources and focusing on any issues and trends that may need attention in order to reduce incidents and increase public and worker safety.

Director's Role

The program directors are responsible for providing direction and overall leadership for their program areas, including the engineering and inspection functions. They also have delegated statutory powers under the Act for all general supervisory and administrative issues with respect to all parts of the Act.

¹³ Limited to escalators, elevators and fuels appliances.

Boilers and Pressure Vessels and Operating Engineers

Commentary on Key Findings

- The Boilers and Pressure Vessels and Operating Engineers Safety Program is in an evolutionary state at this time regarding data as capabilities of the new enterprise resource management system are exploited. With the elimination of the backlog in the Operating Engineers program, the TSSA database is in excellent condition pertaining to plant status. The next step is to identify all pressure vessels associated with those plants. In parallel, the TSSA database for the Boilers and Pressure Vessels program is under review and the insurer databases are coming under review. It is expected that these data initiatives will assist TSSA greatly in its vision of attaining a comprehensive understanding of the composition and inspection status of all pressure vessels in Ontario. In the meantime, TSSA and its insurer partners shall continue to maintain the very positive safety outcomes, as evidenced by historical and current incident data.

Responses and Actions to Observations for Consideration

- BPV-1: TSSA is working with the insurance industry to develop a mutually beneficial process by which the status of all insured pressure retaining components in Ontario is known and appropriate actions taken to assure public safety. The current action plan has TSSA continuing to fulfill its responsibility of inspecting uninsured pressure vessels and following through with a quality assurance process in fiscal year 2012/2013, and reviewing insurance companies' inspection quality programs. In addition, quantitative reviews of existing TSSA and insurer data sets and data retrieval processes will be undertaken to assess gaps and develop plans for delivering the above-mentioned mutually beneficial process.
- BPV-2: TSSA is also working with the industry advisory council to investigate means for capturing any near-misses. A communication plan is being implemented in fiscal year 2012/2013 to remind the owners of boilers and pressure vessels and TSSA-certified boilers and pressure vessel repair organizations that there are specific reporting obligations in the regulation that pertain to the reporting of accidents and the registration of all boilers and pressure vessels.
- OE-1: TSSA is continuing to refine the risk-informed inspection process by further validating the risk formulae and identifying discrepancies between assigned and required risk assignments. This includes such examples as seasonal plants, customer shut-down plants and sealed plants. In addition, it is expected that the recent decreases in compliance (0.45% overall and 0.66% institutional) will reverse themselves in the next year or so as the Operating Engineers program ensures that every plant continues to be inspected in accordance with the risk schedule, which should result in improving plant compliance and overall safety.

Other Actions

A number of years ago, TSSA identified a possible shortage of skilled operating engineers. In this regard, TSSA is continuing to work with operators and training organizations to address the future of operating engineers in Ontario. Options being considered range from increasing the availability and visibility of training programs through college, to modernizing the *Operating Engineers Regulation* to ease requirements for training, plant certification and experience. Dialogue with the Institute of Power Engineers as well as convening an advisory council risk reduction group is ongoing in this regard.

Elevating Devices and Amusement Devices

Commentary on Key Findings

The percentage of elevators found to be compliant during periodic inspections was 33.67%. This is down 36.62% from the previous year. This reduction in compliance levels can be attributed to the elevators, escalators and moving walks periodic inspection backlog project that saw the elimination of all backlogged periodic inspections and included inspections of devices that had not been inspected in the past three years which, as expected, were less compliant.

Over the past eight years, the average number of follow-up inspections required to resolve non-compliances is 1.6. TSSA's goal is to reduce this number through improved compliance which will free up inspectors to conduct more periodic inspections.

Responses and Actions to Observations for Consideration

- AD-1: TSSA continues to work with amusement park operators on its public education program in an effort to reduce incidents related to user behaviour through its education campaigns at major water parks, go-kart facilities and provincial fairs which target higher-risk pre-teen riders, resulting in over 100,000 direct face-to-face interactions.
- AD-2: The risk reduction group on ageing amusement devices continues to look at risks posed by ageing devices. TSSA Advisory Bulletin 522/12 reminded owners of the requirements for welding repairs of cracks and the associated non-destructive testing requirements.
- ED-1: The risk reduction group looking at ageing elevating devices is now focused on elevators with single and two speed motion control and the associated risks to passengers when the elevators do not stop at the prescribed level. This could lead to a replacement of these older control systems in the near future.
- ED-2: TSSA partnered with the Association of Day Care Operators of Ontario, the Older Adult Centres Association of Ontario, Brookfield Properties, Cadillac Fairview, Oxford Properties Group and the Toronto Transit Commission to promote escalator safety to over 660,000 higher risk riders.
- ED-3: In order to improve compliance levels on elevating devices, TSSA will be providing data to contractors on their performance compared to the industry average. For contractors who fall well below the industry average, this will provide information on areas for improved compliance.

Other Actions

There appears to be reluctance in the reporting of incidents by amusement ride operators. Incident data is critical to TSSA in establishing the overall state of public safety for amusement devices in the province. When TSSA is made aware of incidents that should have been reported, it audits the operator's records for all instances where patrons received medical attention. This provides data on all reportable incidents that were not reported to TSSA and leads to enforcement/education actions to rectify the lack of incident reporting.

The adoption of the new ASME *A17.1/CSA B44 Safety Code for Elevators and Escalators*, will mandate replacement of all single bulkhead hydraulic cylinders and require all existing escalators to conform to the step/skirt performance index requirements. These replacement/retrofits must be completed by May 1, 2015 and will eliminate the risk of catastrophic failures of single bulkhead hydraulic cylinders and reduce entrapments between escalator skirts and steps. These are in response to risk assessments conducted on known safety issues and reported in previous versions of this report.

TSSA issued a communication to elevating device owners reminding them of their legal responsibilities with regard to elevator maintenance and oversight of their maintenance contractors and advising of new requirements and the timeline in which they will become effective so they can better plan for improved compliance.

Fuels

Commentary on Key Findings

For the last fiscal year, while there continues to be a downward trend in occurrences of fuels incidents, the majority (90.4%) that continue to occur are in the utilization stage of the life cycle and this trend has continued to rise. Approximately 25% of these incidents are attributed to carbon monoxide releases with the majority occurring in residential dwellings. As such, public education remains a key risk mitigation strategy; and TSSA continues to design and implement innovative engagement campaigns focused on increasing awareness, enhancing understanding and modifying user behaviours to assist in addressing this dominant root cause for carbon monoxide incidents. While progress is being made, additional efforts are required to further mitigate this public safety risk. The majority (80%) of completed occurrence inspections indicate these fuels incidents were the result of non-compliance with the regulations.

The introduction of the Director's Order for natural draft boilers reported last year was seen as a first step in addressing the lack of maintenance in residences. Preliminary analysis is indicating positive results from the Director's Order. Inspections occurring as a result of the Director's Order have averted several potential health impacts to equipment users. Impact of the Director's Order will continue to be monitored. Fuel supplier audits were also seen as a way to gain better insights into the lack of maintenance.

Another emerging area of concern is with institutional buildings with sensitive sub-populations such as in nursing homes and long-term care facilities. These types of facilities have been identified as a potential risk due to non-compliance with the regulations.

Damage to underground natural gas pipelines continues to be an area of concern particularly in the area of locating, and excavation practices. This will be addressed through stricter enforcement and increased inspection fees for both damages and excavating without a valid pipeline locate.

Responses and Actions to Observations for Consideration

- FS-1: Carbon monoxide releases continue to be a major cause of fuel incidents. To address these incidents, TSSA has a comprehensive education program for the general public and will continue to build on past research and insights gained through the execution of its engagement campaigns to further enhance public education. Additional efforts are required to further mitigate this risk and, as such, TSSA will be exploring a number of options including, for example, refining/expanding its existing initiatives and engaging industry partners to explore other effective ways to get appropriate safety information to the general public. And finally, TSSA will continue to monitor the impact of the Director's Order in reducing carbon monoxide incidents associated with natural draft boilers.
- FS-2: Fuel supplier audits conducted as a pilot program last year will be evolved into a formal program as a way to review compliance and also assist in better understanding risk in private dwellings. TSSA does not have jurisdiction to enter private dwellings to assess proper maintenance of fuel-fired equipment. The *Technical Standards and Safety Act, 2000* allows private citizens to refuse entry to an inspector. TSSA therefore relies on the fuel distributor to do their mandated ten-year inspection to ensure public safety. The audit process focuses on the quality of these inspections.

Other Actions

Risks at institutional buildings and facilities need to be evaluated to determine the requirement for a targeted inspection program. To evaluate the need for a more comprehensive program, TSSA will be conducting a pilot inspection program targeted at institutional buildings to determine the extent of non-compliances in this population. After completing a predetermined number of inspections, a detailed analysis of the findings will take place. Further steps will be determined based on the findings.

Damage to underground natural gas pipelines continues to be a leading cause of incidents. To address these incidents, TSSA will be conducting safety presentations to appropriate stakeholders, continue to conduct "Dig Safe" days to audit excavation sites across the province, and support initiatives of the Ontario Regional Common Ground Alliance. In addition, TSSA will be introducing increased fees for pipeline damage inspections and excavating around pipelines without a valid locate as a financial deterrent.

Upholstered and Stuffed Articles

Commentary on Key Findings

The manufacturing of furniture with contaminated filling materials, such as moldy frames and rusty border wires is a major concern for TSSA. TSSA continues to aggressively inspect the mattress, furniture and bedding industry to ensure that contaminated materials are not being sold to consumers. Orders are issued to destroy contaminated articles.

The systematic inspections at retailers and domestic stakeholders are a primary source for identifying unregistered manufacturers. TSSA continues to educate customers on the requirements of the regulation, which leads to compliance.

TSSA inspectors are constantly challenged by changing market place trends. Inspection orders are issued to bring these new articles into compliance with the regulation.

Responses and Actions to Observations for Consideration

- USA-1: The TSSA initiative related to the standardization of inspection orders will support the documentation of specific infraction types identified during inspections.

Other Actions

Through the inspection process, TSSA continues to ensure contaminated furniture and mattresses are not being sold after investigations uncovering molded sofa sets and rusty border wires.

Due to competition issues, some domestic customers are changing their manufacturing process without ensuring compliance to the regulation. As such, TSSA is diligent in identifying non-conformance to the regulation from all domestic manufacturers.

There is an increased level of third party agents brokering transactions between importers/distributors and manufacturers. These newer agents need to be educated with respect to the regulation.

Boilers and Pressure Vessels and Operating Engineers

Boilers and Pressure Vessels

The Boilers and Pressure Vessels and Operating Engineers Safety Program operates within a strong regulatory and standards infrastructure which provides a profound “defence-in-depth” for protecting the Ontarian public from any incidents involving pressure vessels. TSSA is involved in all aspects of the life cycle of pressure vessels: from design, to manufacture, to installation, to operation and maintenance, to decommissioning plus the certification of operators.

Boilers and pressure vessels include equipment that produces and distributes hot water, steam, compressed air, and other compressed liquids and gases used in commerce and industry. TSSA is responsible for regulating all pressure retaining components manufactured or used in Ontario, with a commitment to ensuring the safety of boilers, pressure vessels and piping systems. TSSA conducts periodic inspections on uninsured boilers and pressure vessels in Ontario. The remaining insured boilers and pressure vessels are inspected by insurance companies licensed to underwrite boiler and machinery insurance. TSSA is responsible for the certification of the inspectors employed by the insurance companies.

Incidents involving this type of equipment and associated piping are infrequent. Nevertheless, cracked and corroded vessels or piping can leak or rupture, producing a variety of safety problems, including poisonings, suffocations, fires or explosions. Ruptures can be catastrophic and may immediately threaten life and property. The safe design, installation, operation, and maintenance of pressure vessels in accordance with appropriate codes and standards are essential to public safety. TSSA’s activities help ensure that safeguards are in place for the life cycle of this type of equipment.

Analysis on State of Public Safety and Compliance

Occurrence Analysis

Table BPV-1 summarizes the occurrences involving boilers and pressure vessels reported to TSSA in accordance with the reporting guidelines provided to stakeholders. These occurrences can be categorized as an incident or a near-miss¹⁴, and the table following includes their occurrence inspection status at the end of the fiscal year. The number of victims and their injury severity from these occurrences are also included.

¹⁴ Please refer to the glossary in Appendix D for the definition of these terms.

Table BPV-1: Reported boilers and pressure vessels occurrences and health impacts.

Occurrence Detail	Number of Occurrences – May 1, 2011 – April 30, 2012
Number of Incidents	3
Number of Near-Misses	0
Occurrences Outside TSSA Jurisdiction	3
Total Reported Occurrences	6
Occurrences Deemed within Jurisdiction	3
Completed Causal Analysis	0
Unable to Establish Root Cause	0
In Progress	3
Not Requiring Formal Inspection	0
Number of Fatalities	0
Number of Permanent Injuries	0
Number of Non-permanent Injuries	0

Occurrence inspections have not yet been completed for the three occurrences indicated in Table BPV-1, and the causal categorization is not available. There were no observed health impacts in this program in the measured period.

Occurrence Related Trends

Figure BPV-1 shows the number of occurrences to which TSSA has responded over the last five fiscal years and the associated causal categorization of these occurrences. A statistical analysis of this data indicates that the number of occurrences involving boilers or pressure vessels does not demonstrate a significant trend over this period. This analysis also reveals that there are no significant trends in the number of occurrences in any of the causal categories. The occurrences in this program are relatively rare.

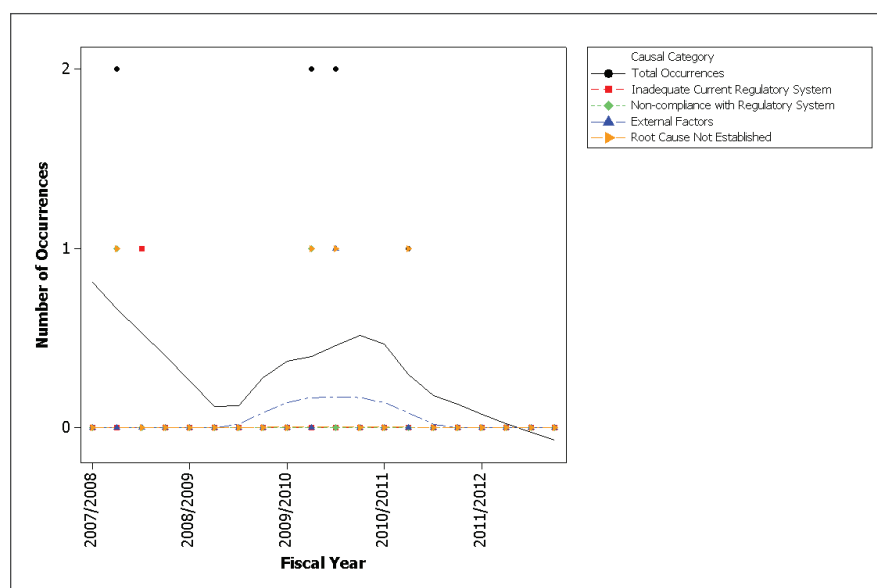
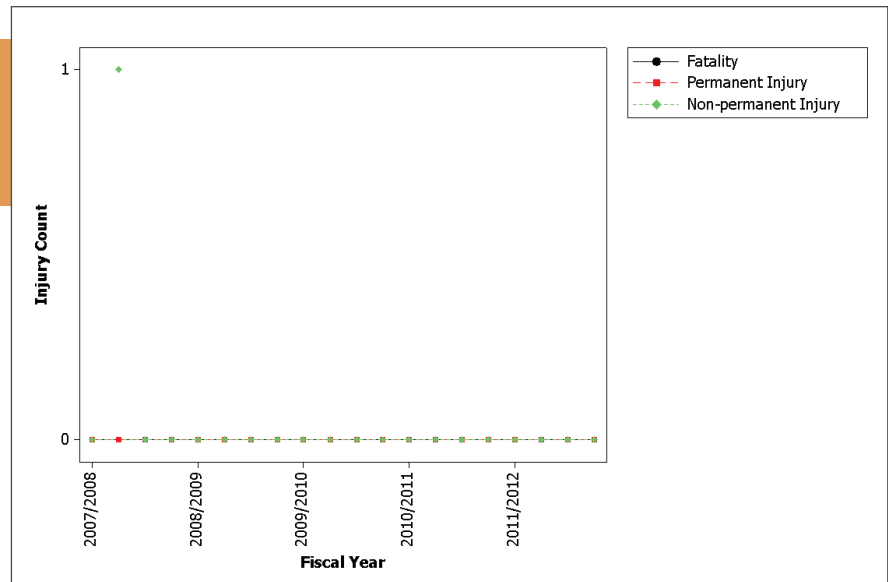


Figure BPV-1: Occurrences involving boilers and pressure vessels over the last five fiscal years.

Figure BPV-2 charts the number of fatalities, permanent injuries and non-permanent injuries involving boilers and pressure vessels over the last five fiscal years. As illustrated, there have been no fatalities or permanent injuries involving boilers and pressure vessels within TSSA's jurisdiction during this period. There was one non-permanent injury in the second quarter of fiscal year 2007/2008.

Figure BPV-2: Fatalities, permanent injuries and non-permanent injuries involving boilers and pressure vessels over the last five fiscal years.



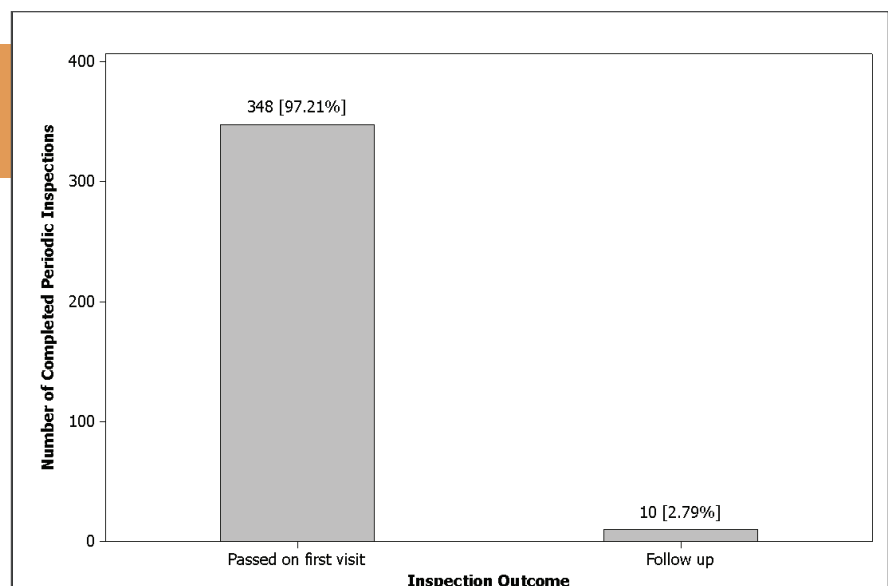
A statistical analysis of the data indicates that the total number of DALYs associated with the injury counts does not demonstrate a significant trend during this period. This analysis also reveals that the number of DALYs in each category do not exhibit significant trends over the measured period.

Compliance Analysis

Periodic Inspections

There were 358 periodic inspections conducted in fiscal year 2011/2012. Each of these inspections results in an outcome as determined by a TSSA inspector, shown in Figure BPV-3. Of all periodic inspections completed in fiscal year 2011/2012., 97.21% were compliant on the first visit. Please note that the periodic inspections analyzed here only cover visits to facilities inspected by TSSA; that is, uninsured devices.

Figure BPV-3: Outcomes from boilers and pressure vessels periodic inspections completed in fiscal year 2011/2012.



TSSA inspectors issued a total of six inspection orders during the course of these periodic inspections. This yields an average number of inspection orders issued per inspection of 0.0168.

Compliance Related Trends

Figure BPV-4 charts the number of periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that the number of periodic inspections demonstrates a decreasing trend over the period at a rate of 2.49 inspections per quarter.

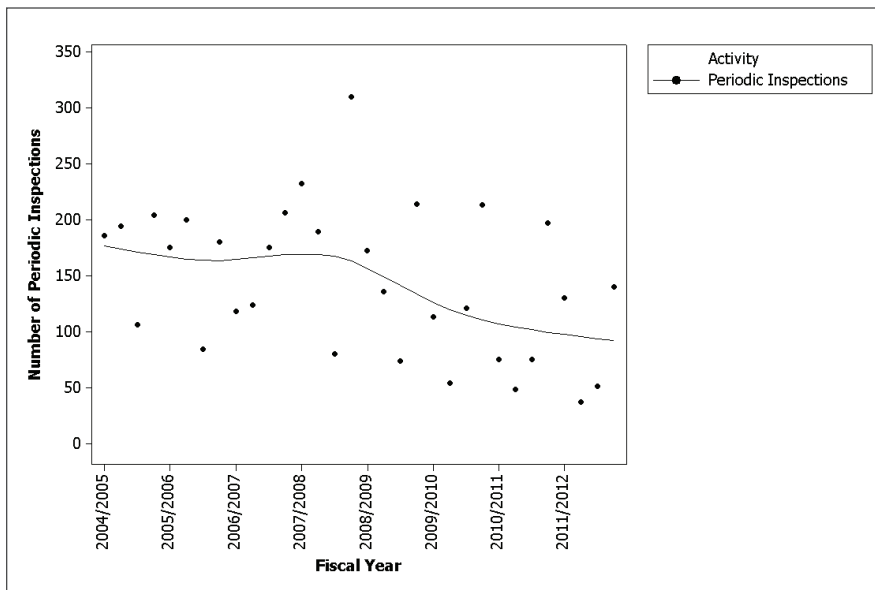


Figure BPV-4: Boilers and pressure vessels periodic inspections completed over the last eight fiscal years.

Figure BPV-5 provides the average number of inspection orders per inspection for the last eight fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per inspection does not demonstrate a significant trend over the period.

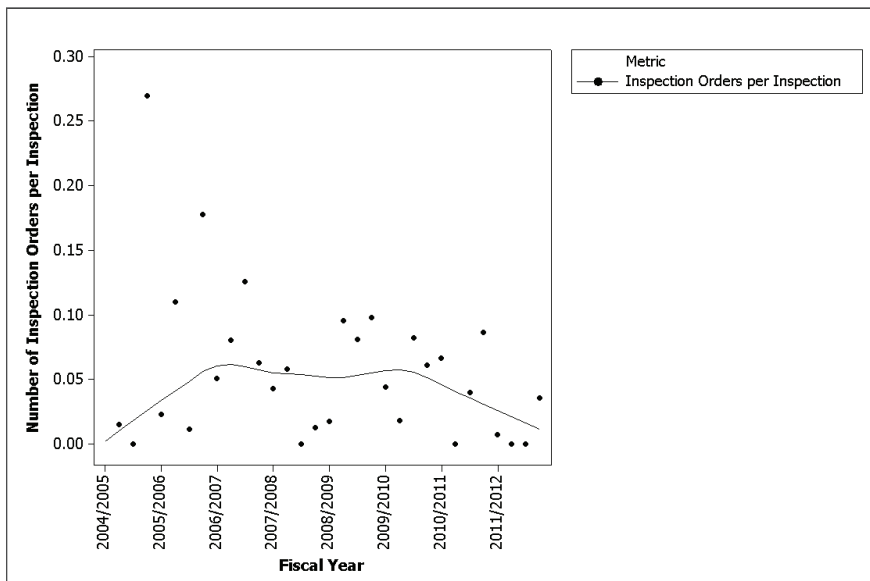
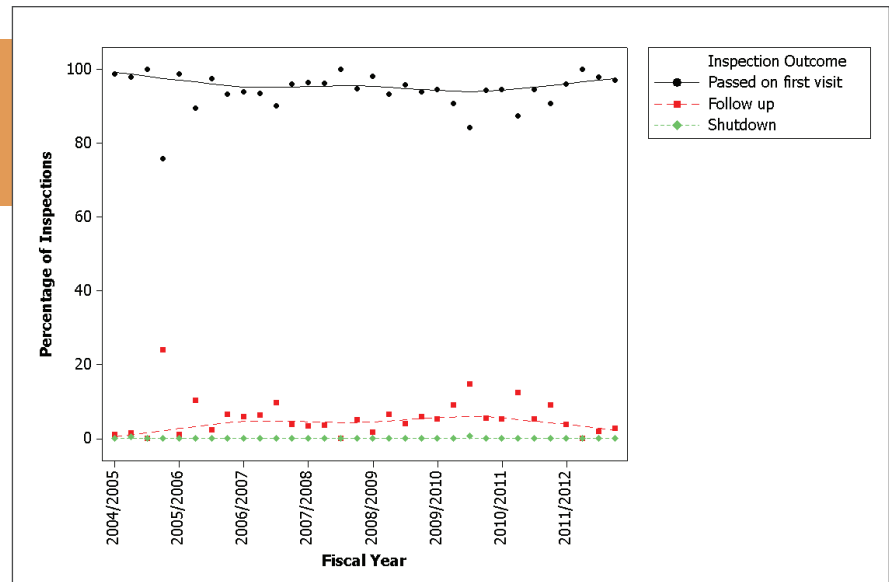


Figure BPV-5: The average number of inspection orders per boilers and pressure vessels periodic inspection over the last eight fiscal years.

Figure BPV-6 charts the outcomes from the periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that all of the inspection outcomes do not demonstrate significant trends within the measured period. Since the average number of inspection orders per inspection is low, the level of compliance is expected to be high. Indeed, the analysis shows that the percentage of inspections compliant with regulations on first visit dominates compared to all other inspection outcomes.

Figure BPV-6: The inspection outcomes of boilers and pressure vessels periodic inspections completed over the last eight fiscal years.



Other Safety and Risk Analysis Results

The prediction intervals for the compliance outcomes for boilers and pressure vessels, which represent the expected ranges of the indicator and are defined by the fifth and ninety-fifth percentiles of the trend data, are indicated in Table BPV-2.

Table BPV-2: Prediction intervals for compliance outcomes from boilers and pressure vessels for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Periodic Inspections	Percentage Passed on First Visit	81.39%	100.00%
	Percentage Follow-up	0.00%	18.08%
	Percentage Shutdown	0.00%	0.62%
	Number of Orders per Inspection	0.00	0.21

The prediction intervals generated from the trend data for the safety outcomes for boilers and pressure vessels are indicated in Table BPV-3.

Table BPV-3: Prediction intervals for safety outcomes from boilers and pressure vessels for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Occurrences	Number of Fatalities	0	0
	Number of Permanent Injuries	0	0
	Number of Non-permanent Injuries	0	1

Risk Assessments

An assessment is being conducted to determine the necessity for the re-introduction of internal inspections of boilers in response to concerns raised by industry and the insurance sector. The current inconsistency in the interpretation of the regulatory requirements associated with periodic internal inspections of equipment may pose safety concerns in the future. A risk reduction group involving TSSA personnel, industry experts and representatives from insurance companies was constituted and is currently engaged in determining appropriate strategies. A safety assessment was undertaken including collecting and analyzing information from other jurisdictions as a primary input into the decision-making process. It is anticipated that a decision will be made in this regard in 2013.

Operating Engineers

Operating engineers, also known as power engineers in jurisdictions outside Ontario, are certified professional power plant managers and operators who oversee the provision of energy, climate control, electric power or other utilities for thermal-electric generating stations, industrial processes and facilities. They manage, operate and maintain boilers, steam turbines and engines, gas compression plants, refrigeration plants, and associated mechanical and electrical systems in power generation, industrial processes and environmental system plants.

Depending upon the size of a specific facility, operating engineers may also manage, operate and maintain all physical facility operations. Large power plants have several operating engineers for each shift, designated as shift engineers and assistant shift engineers. In all cases, a chief operating engineer is responsible for the entire plant management, operation and maintenance. The Operating Engineers program area is responsible for registering, inspecting and regulating the safety of approximately 2,900 plants in Ontario. In addition, the program is responsible, under the regulation, for the examination and certification of over 12,100 operating engineers and operators to confirm their qualifications. These activities ensure that all operating engineers and operators in Ontario have the skills and knowledge to safely manage, operate and maintain registered power plants.

Analysis on State of Public Safety and Compliance

Occurrence Analysis

Table OE-1 summarizes the occurrences involving operating plants reported to TSSA in accordance with the reporting guidelines provided to stakeholders. These occurrences can be categorized as an incident or a near-miss, and the table includes their occurrence inspection status at the end of the fiscal year. The number of victims and their injury severity from these occurrences are also included.

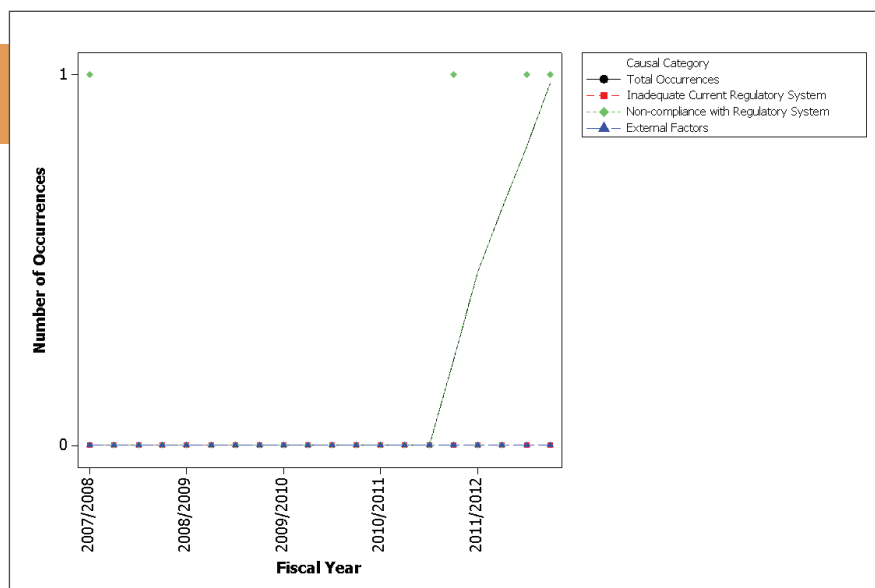
Table OE-1: Reported occurrences for operating plants occurrences and health impacts

Occurrence Detail	Number of Occurrences — May 1, 2011 – April 30, 2012
Number of Incidents	2
Number of Near-Misses	0
Occurrences Outside TSSA Jurisdiction	0
Total Reported Occurrences	2
Occurrences Deemed within Jurisdiction	2
▪ Completed Causal Analysis	2
▪ Unable to Establish Root Cause	0
▪ In Progress	0
▪ Not Requiring Formal Inspection	0
Number of Fatalities	0
Number of Permanent Injuries	0
Number of Non-permanent Injuries	0

Occurrence Related Trends

Figure OE-1 shows the number of occurrences to which TSSA has responded over the last five fiscal years and the associated causal categorization of these occurrences. A statistical analysis of this data indicates that the number of occurrences involving operating engineers does not demonstrate a significant trend over the period. This analysis also reveals that there are no significant trends in the number of occurrences in any of the causal categories. The occurrences in this program are relatively rare.

Figure OE-1: Occurrences at operating plants over the last five fiscal years.



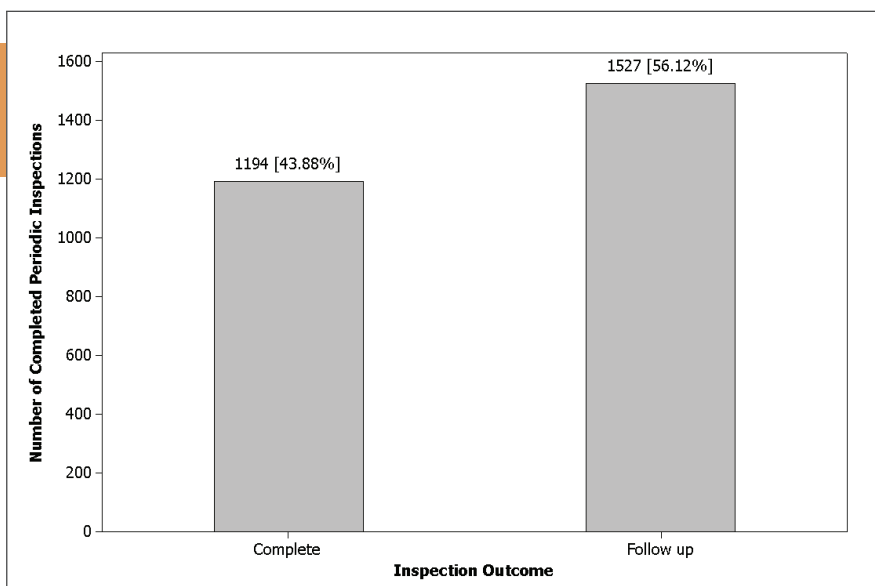
There were no fatalities, permanent injuries or non-permanent injuries over the last five fiscal years.

Compliance Analysis

Periodic Inspections

There were 2,721 periodic inspections conducted in fiscal year 2011/2012. Each of these inspections resulted in an outcome as determined by a TSSA inspector, shown in Figure OE-2. Of all periodic inspections completed in fiscal year 2011/2012, 43.88% were compliant on the first visit.

Figure OE-2: Outcomes from operating plant periodic inspections completed in fiscal year 2011/2012.



TSSA inspectors issued a total of 5,941 inspection orders during the course of these periodic inspections. This yields an average number of inspection orders issued per inspection of 2.18.

Compliance Related Trends

Figure OE-3 charts the number of periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that the number of periodic inspections does not demonstrate a significant trend over the period.

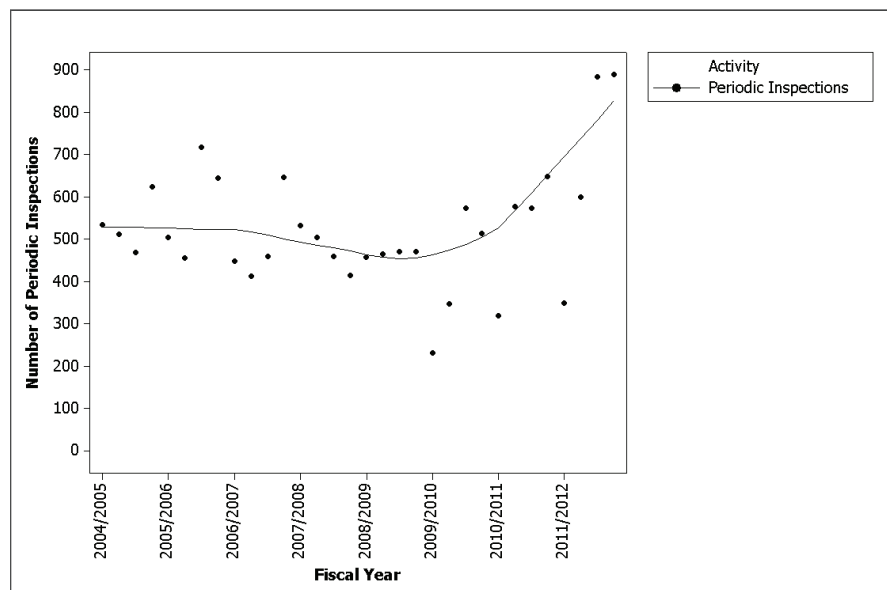


Figure OE-3: Operating plant periodic inspections completed over the last eight fiscal years.

Figure OE-4 provides the average number of inspection orders per inspection for the last eight fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per inspection demonstrates a decreasing trend over the period at a rate of 0.04 per quarter.

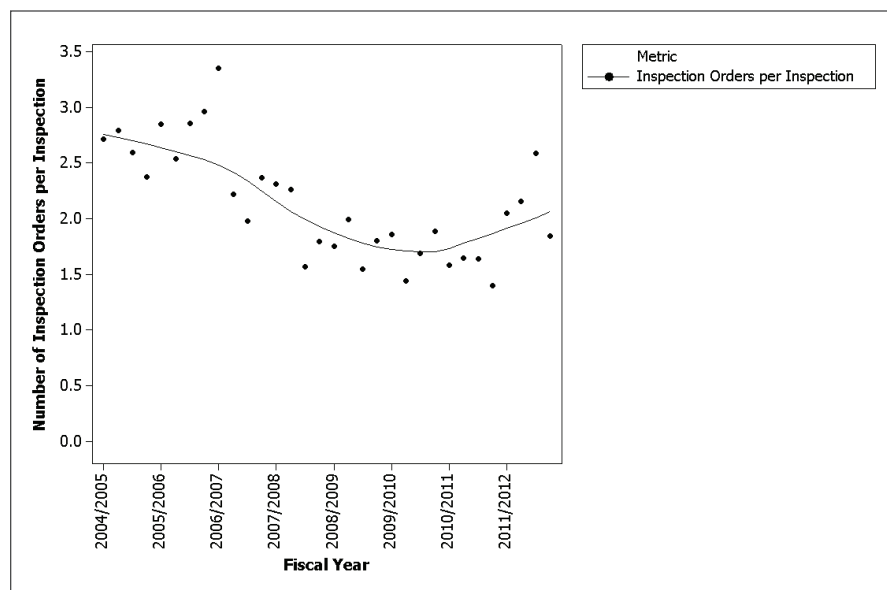
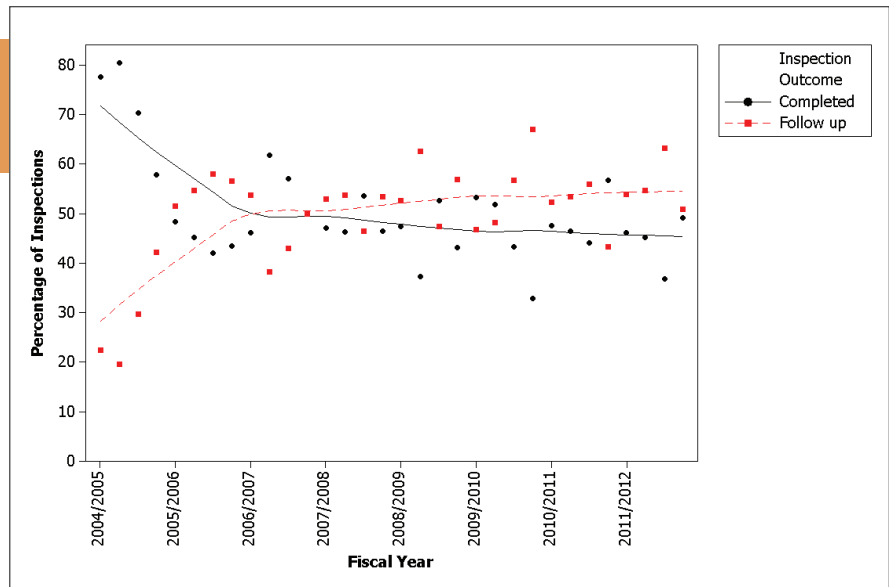


Figure OE-4: The average number of inspection orders per operating plant periodic inspection over the last eight fiscal years.

Figure OE-5 charts the outcomes from the periodic inspections over the last eight fiscal years. A statistical analysis of this data over the entire period indicates there is an increasing trend in the percentage of 'Follow-up' inspection outcomes at a rate of 0.45% per quarter, and a decreasing trend in the percentage of 'Complete' inspection outcomes at a rate of 0.45% per quarter. 'Complete' inspection outcomes indicate that any non-compliances found have been resolved by the end of the inspection.

Figure OE-5: The inspection outcomes of operating plant periodic inspections conducted over the last eight fiscal years.



Other Safety and Risk Analysis Results

The prediction intervals for the compliance outcomes for operating plants, which represent the expected ranges of the indicator and are defined by the fifth and ninety-fifth percentiles of the trend data, are indicated in Table OE-2.

Table OE-2: Prediction intervals for compliance outcomes from operating engineers for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Periodic Inspections	Percentage Complete	35.43%	78.57%
	Percentage Follow-up	21.43%	64.57%
	Number of Orders per Inspection	1.43	3.10

Elevating Devices and Amusement Devices

Amusement Devices

TSSA regulates over 1,550 amusement devices in Ontario by ensuring all rides conform to the *Technical Standards and Safety Act, 2000* and applicable regulations, codes and standards. TSSA reviews and registers rides, issues permits for each ride in the current operating season, licenses operators, conducts inspections and incident investigations, and delivers public awareness campaigns throughout the province. Amusement devices under TSSA's jurisdiction include roller coasters, ferris wheels, merry-go-rounds (and other circular motion rides), water slides, flume rides, dry slides, go-karts, bumper carts, inflatables (inflatable bouncers), bungee devices, bungee-assisted bounces, zip lines (track and cable rides), and other generic spinning and whirling rides. The trend analysis presented in this section should be considered in the context that the operation of these devices is predominantly seasonal in nature. The trend analysis confirmed the seasonality and took it into account while establishing historical patterns of safety and compliance performance.

Analysis on State of Public Safety and Compliance

Occurrence Analysis

Table AD-1 summarizes the amusement devices occurrences reported to TSSA in accordance with the reporting guidelines provided to stakeholders. These occurrences can be categorized as an incident or a near-miss and Table AD-1 includes their occurrence inspection status at the end of the fiscal year. The number of victims and their injury severity from the occurrences are also included.

Occurrences not requiring formal inspections do not involve a device-related failure. These are attributed to human factors that are outside of the control or influence of TSSA and have been treated accordingly in the health impact analysis.

Table AD-1: Reported amusement device occurrences and health impacts.

Occurrence Detail	Number of Occurrences — May 1, 2011 – April 30, 2012
Number of Incidents	219
Number of Near-Misses	8
Occurrences Outside TSSA Jurisdiction	0
Total Reported Occurrences	227
Occurrences Deemed within Jurisdiction	227
▪ Completed Causal Analysis	0
▪ Unable to Establish Root Cause	0
▪ In Progress	123
▪ Not Requiring Formal Inspection	104
Number of Fatalities	0
Number of Permanent Injuries	3
Number of Non-permanent Injuries	215

The three permanent injuries occurred on the following devices: a flume ride, a water slide, and a zip line. The inspections for the first two occurrences have not yet been completed. The third occurrence was determined to be a result of factors external to the regulatory system. The full causal categorization for the fiscal year is presented in Table AD-2. The following categorization applies to occurrences wherein an inspection has been completed or did not require a formal inspection.

Table AD-2: Causal categorization for amusement devices occurrences.

Causal Category	Number of Occurrences	Percentage of Occurrences	Health Impacts (DALYs)	Percentage of Total Health Impacts
1. Inadequate Current Regulatory System	0	0.00%	0.0000	0.00%
2. Non-compliance with Regulatory System	1	0.96%	0.0008	0.40%
3. External Factors	103	99.04%	0.1984	99.60%
4. Root Cause Not Established	0	0.00%	0.0000	0.00%

Occurrence Related Trends

Figure AD-1 shows the number of occurrences to which TSSA has responded over the last five fiscal years and the associated causal categorization of these occurrences. A statistical analysis of this data indicates that the number of occurrences on amusement devices does not demonstrate a significant trend over the five-year period. This analysis also reveals that the number of occurrences due to non-compliance with the regulatory system exhibits a decreasing trend over the measured time at a rate of 0.125 occurrences per quarter. All other causal categories do not show a significant trend. The primary contributor to the occurrences due to external factors continues to be ‘failure to follow user instructions’.

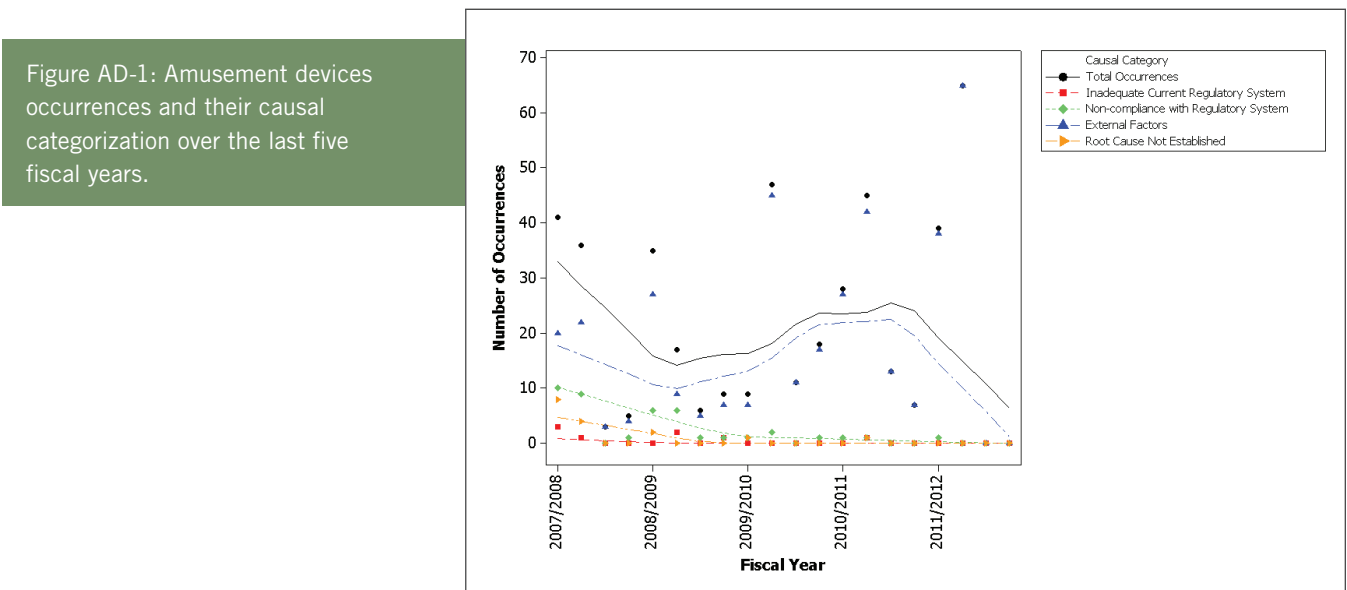


Figure AD-2 charts the number of amusement device fatalities, permanent injuries and non-permanent injuries over the last five fiscal years. As illustrated, there have been no fatalities on amusement devices within TSSA’s jurisdiction during this period. A statistical analysis of this data indicates that the number of permanent injuries and non-permanent injuries do not demonstrate a significant trend over the measured time.

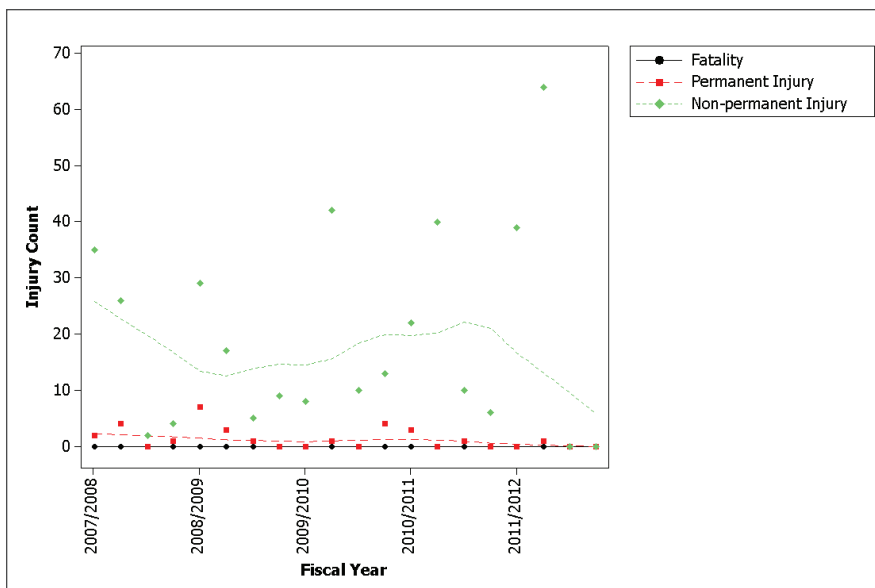


Figure AD-2: Amusement devices fatalities, permanent injuries and non-permanent injuries over the last five fiscal years.

A statistical analysis of the data indicates that the total number of DALYs associated with the injury counts demonstrates a decreasing trend over the measured period at a rate of 0.0225 DALYs per quarter. This analysis also reveals that the health impacts associated with non-compliance with the regulatory system exhibits a decreasing trend over the measured time at a rate of 0.0004 DALYs per quarter. All other causal categories do not show a significant trend.

Compliance Analysis

Periodic Inspections

There were 1,552 periodic inspections conducted in fiscal year 2011/2012. Each of these inspections results in an outcome as determined by a TSSA inspector, shown in Figure AD-3. Of all periodic inspections completed in fiscal year 2011/2012, 61.40% were compliant with regulations on the first visit.

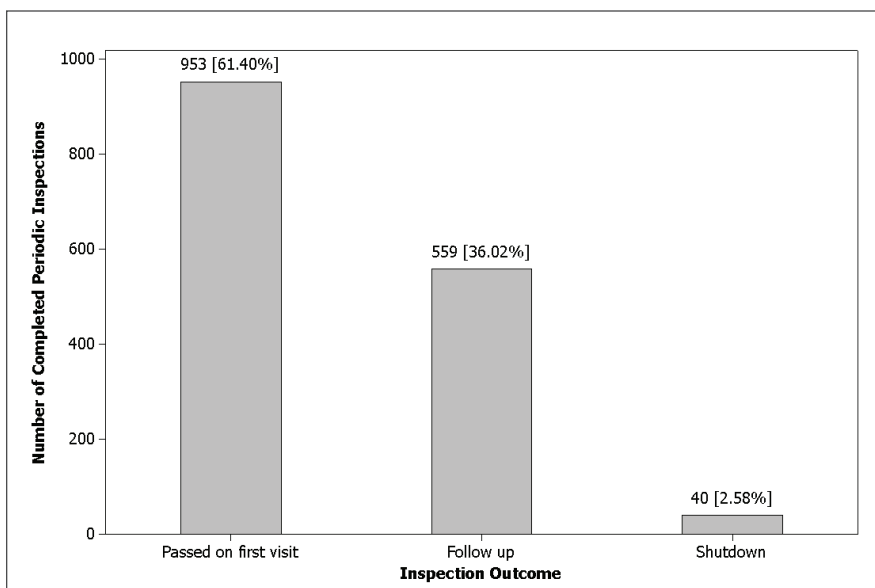


Figure AD-3: Outcomes from amusement device periodic inspections completed in fiscal year 2011/2012.

TSSA inspectors issued a total of 1,667 inspection orders during the course of these periodic inspections. This yields an average number of inspection orders issued per inspection of 1.07.

Compliance Related Trends

Figure AD-4 charts the number of periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that the number of periodic inspections does not demonstrate a significant trend over the period.

Figure AD-4: Amusement device periodic inspections completed over the last eight fiscal years.

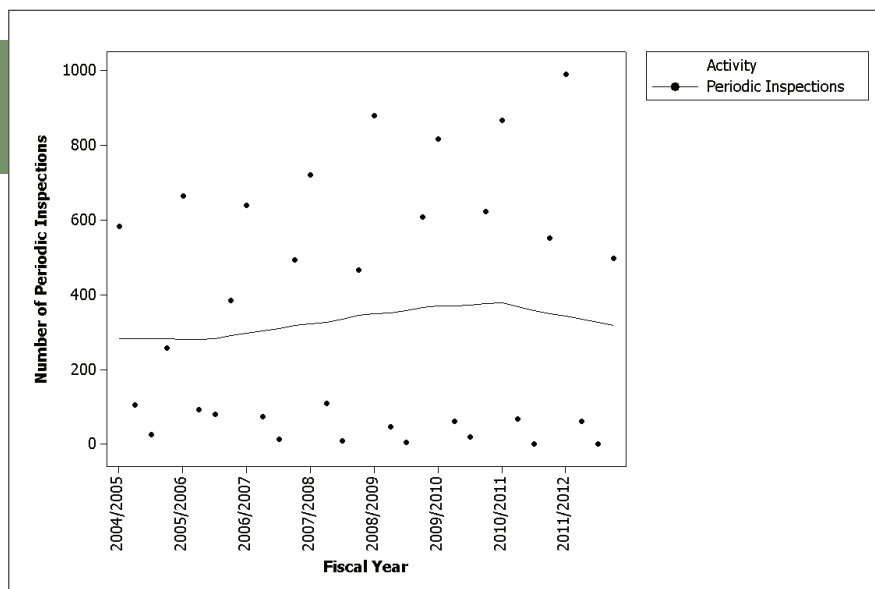


Figure AD-5 provides the average number of inspection orders per inspection for the last eight fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per inspection demonstrates a decreasing trend over the period at a rate of 0.02 orders per inspection per quarter.

Figure AD-5: The average number of inspection orders per amusement device periodic inspection over the last eight fiscal years.

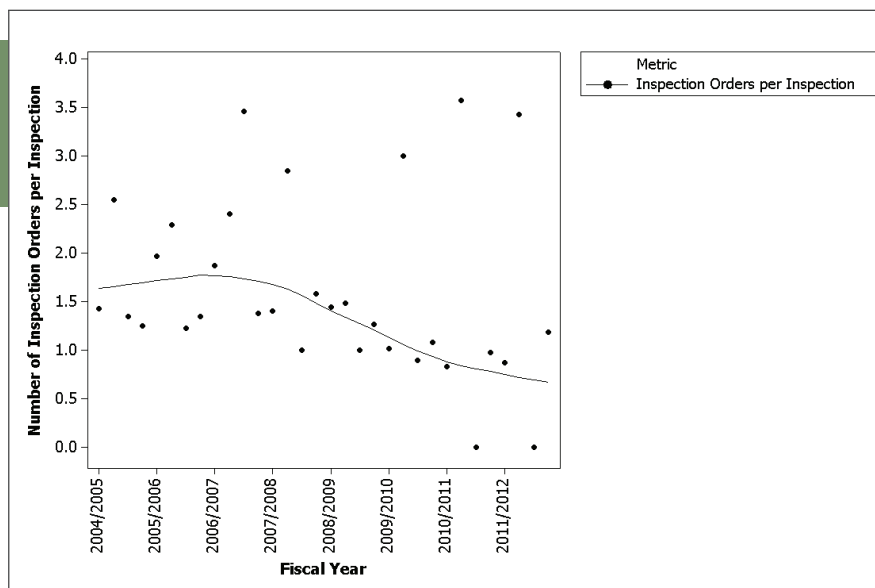


Figure AD-6 charts the outcomes from the periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that there is a decreasing trend in the percentage of 'Follow-up' inspection outcomes over the period at a rate of 0.49% per quarter. This analysis also reveals that the percentage of 'Shutdown' inspection outcomes and the percentage of 'Passed on first visit' inspection outcomes do not exhibit significant trends.

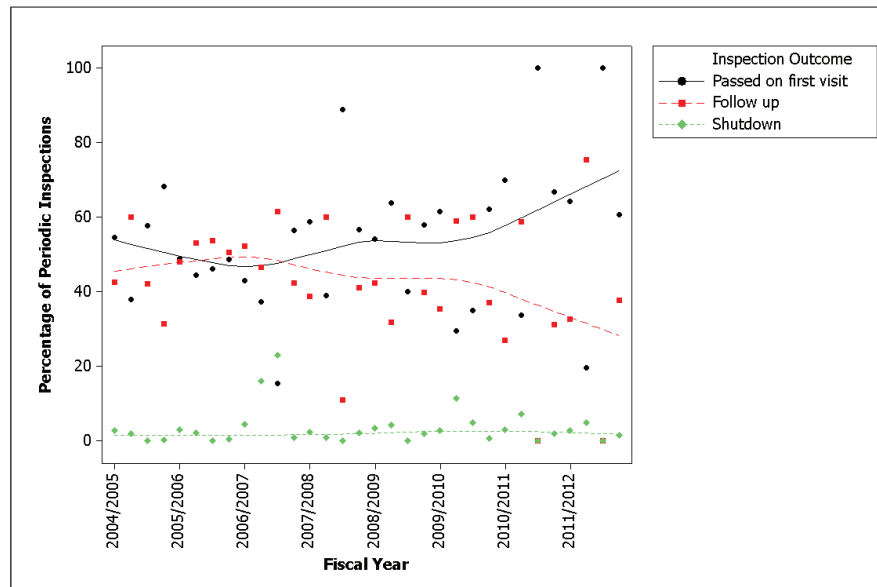


Figure AD-6: The inspection outcomes of amusement device periodic inspections completed over the last eight fiscal years.

Other Safety and Risk Analysis Results

The prediction intervals for the compliance outcomes for amusement devices, which represent the expected ranges of the indicator and are defined by the fifth and ninety-fifth percentiles of the trend data, are indicated in Table AD-3.

Table AD-3: Prediction intervals for compliance outcomes for amusement devices for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Periodic Inspections	Percentage Passed on First Visit	18.17%	100.00%
	Percentage Follow-up	0.00%	66.39%
	Percentage Shutdown	0.00%	18.48%
	Number of Orders per Inspection	0.00	3.50

The prediction intervals generated from the trend data for the safety outcomes for amusement devices are indicated in Table AD-4.

Table AD-4: Prediction intervals for safety outcomes for amusement devices for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Occurrences	Number of Fatalities	0	0
	Number of Permanent Injuries	0	7
	Number of Non-permanent Injuries	0	63

Predicted Health Impacts

The mean predicted health impact is 0.1 fatality-equivalents per million people per year and is found to be within the risk acceptability criteria.

Further analysis indicates that go-karts pose the highest risk followed closely by water slides. There are a number of other amusement devices that collectively contribute to a mean predicted risk of 0.04 fatality-equivalents per million people per year. Further safety issue analysis is likely to provide deeper insight into these other devices including the possibility of aging induced failures. The relative contribution of the devices to the health impacts are shown in Figures AD-7 and AD-8.

Figure AD-7: Predicted health impacts for amusement devices.

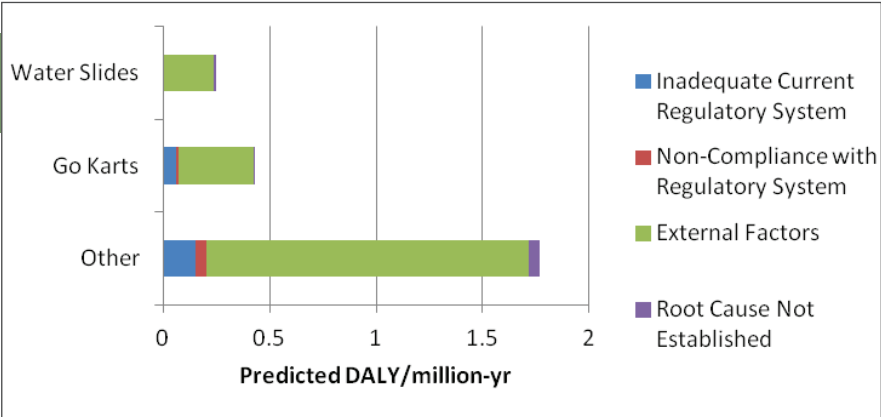
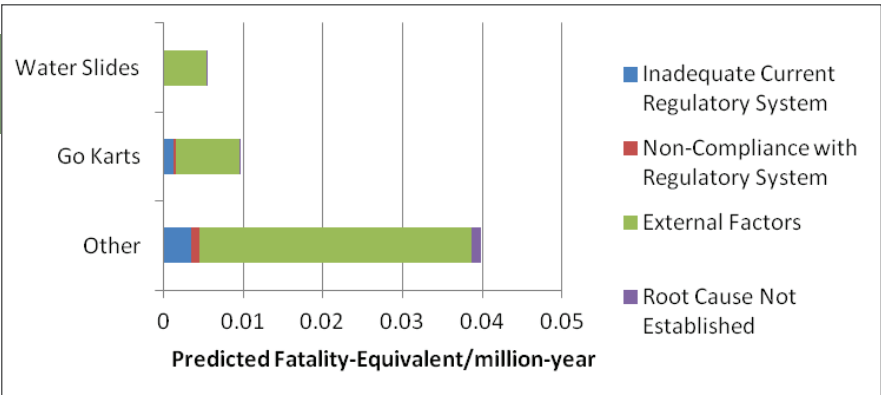
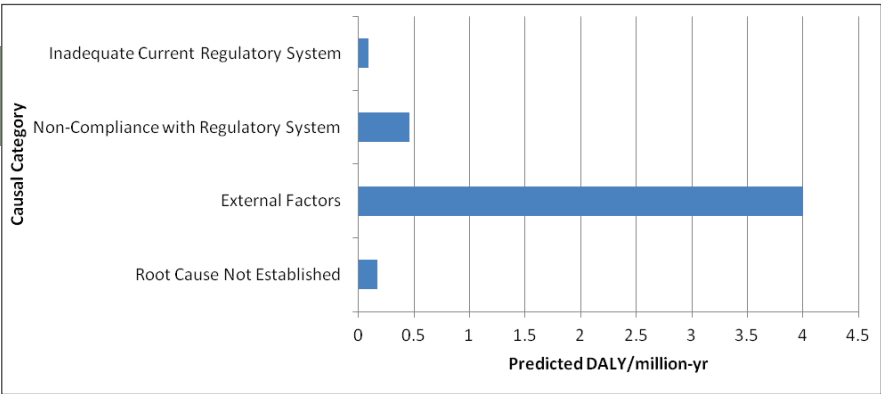


Figure AD-8: Predicted Fatality-Equivalent for amusement devices.



The leading contributor to occurrences is expected to be factors external to the regulatory system as seen in Figures AD-9 and AD-10.

Figure AD-9: Predicted health impacts for amusement devices.



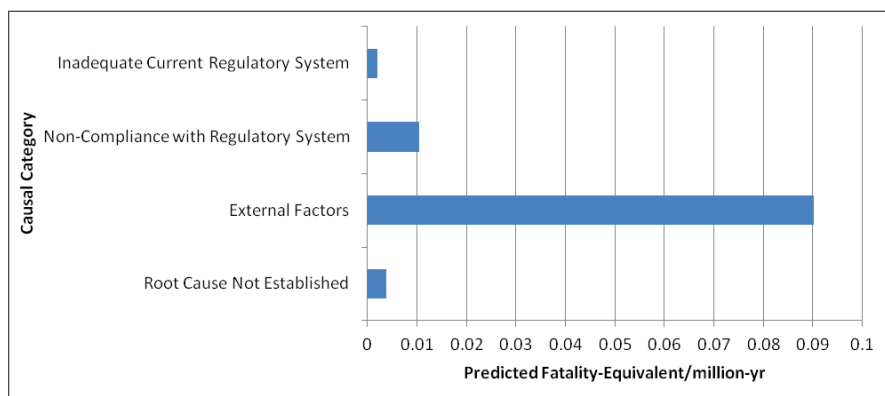


Figure AD-10: Predicted Fatality-Equivalent for amusement devices.

Elevators

TSSA regulates almost 50,000 elevators in Ontario to ensure all devices conform to the *Technical Standards and Safety Act, 2000* and applicable regulations, codes and standards. TSSA reviews and registers elevating devices, issues licences, conducts inspections and performs incident investigations. These devices include elevators (passenger, freight, hand-powered, observation, sidewalk, temporary elevators, and limited use/limited application elevators), dumbwaiters, material and freight platform lifts (type A and B), lifts for persons with physical disabilities, manlifts, construction hoists, incline lifts, stage lifts, and parking garage lifts.

Analysis on State of Public Safety and Compliance

Occurrence Analysis

Table ED-1 summarizes the occurrences on elevators reported to TSSA in accordance with the reporting guidelines provided to stakeholders. These occurrences can be categorized as an incident or a near-miss and the table includes their occurrence inspection status at the end of the fiscal year. The number of victims and their injury severity from the occurrences are also included.

Occurrences not requiring formal inspections do not involve a device-related failure. These are attributed to human factors that are outside of the control or influence of TSSA and have been treated accordingly in the health impact analysis.

Table ED-1: Reported elevator occurrences and health impacts.

Occurrence Detail	Number of Occurrences — May 1, 2011 – April 30, 2012
Number of Incidents	174
Number of Near-Misses	150
Occurrences Outside TSSA Jurisdiction	0
Total Reported Occurrences	324
Occurrences Deemed within Jurisdiction	324
▪ Completed Causal Analysis	68
▪ Unable to Establish Root Cause	3
▪ In Progress	64
▪ Not Requiring Formal Inspection	189
Number of Fatalities	2
Number of Permanent Injuries	10
Number of Non-permanent Injuries	158

Two fatalities occurred on passenger elevators during the measured period. One victim died as a result of injuries sustained when he fell after being struck in the back of the foot by the elevator door as he was exiting the elevator. The occurrence was determined to be due to external factors. The second fatality occurred when an elevator mechanic fell into the hoistway of a passenger elevator. As this fatality involved a worker it falls under the jurisdiction of the Ministry of Labour and TSSA provided technical support to this investigation. The cause was determined to be non-compliance with the regulatory system.

The ten permanent injuries occurred on the following devices: one on a freight platform lift-type B, one on a stair platform lift-type D, one on a freight elevator, and seven on passenger elevators. The occurrences on the freight platform and four of the passenger elevators were due to non-compliance with the regulatory system. The occurrences on the freight elevator and two of the passenger elevators were due to external factors. Occurrence inspections have not yet been completed for the occurrences on the stair platform and the remaining passenger elevator. The full causal categorization for the fiscal year is presented in Table ED-2. The categorization below applies to occurrences wherein an inspection has been completed or did not require a formal inspection.

Table ED-2: Causal categorization for occurrences on elevators

Causal Category	Number of Occurrences	Percentage of Occurrences	Health Impacts (DALYs)	Percentage of Total Health Impacts
1. Inadequate Current Regulatory System	0	0.00%	0.0000	0.00%
2. Non-compliance with Regulatory System	45	17.31%	106.7935	93.65%
3. External Factors	212	81.54%	7.2406	6.35%
4. Root Cause Not Established	3	1.15%	0.0012	0.00%

Occurrence Related Trends

Figure ED-1 shows the number of occurrences to which TSSA has responded over the last five fiscal years and the associated causal categorization of these occurrences. A statistical analysis of this data indicates that the number of occurrences on elevators demonstrates an increasing trend over the period at a rate of 1.50 occurrences per quarter. This analysis also reveals that over the measured time period there is an increasing trend in the number of occurrences due to external factors, at a rate of 2.12 occurrences per quarter. There are decreasing trends in the number of occurrences due to non-compliance with the regulatory system and root cause not established, at the rates of 0.67 occurrences per quarter and 0.15 occurrences per quarter, respectively. The causal category of inadequate current regulatory system does not show significant trends. The primary contributor to the occurrences due to external factors continues to be ‘failure to follow user instructions’.

Figure ED-1: Occurrences involving elevators over the last five fiscal years.

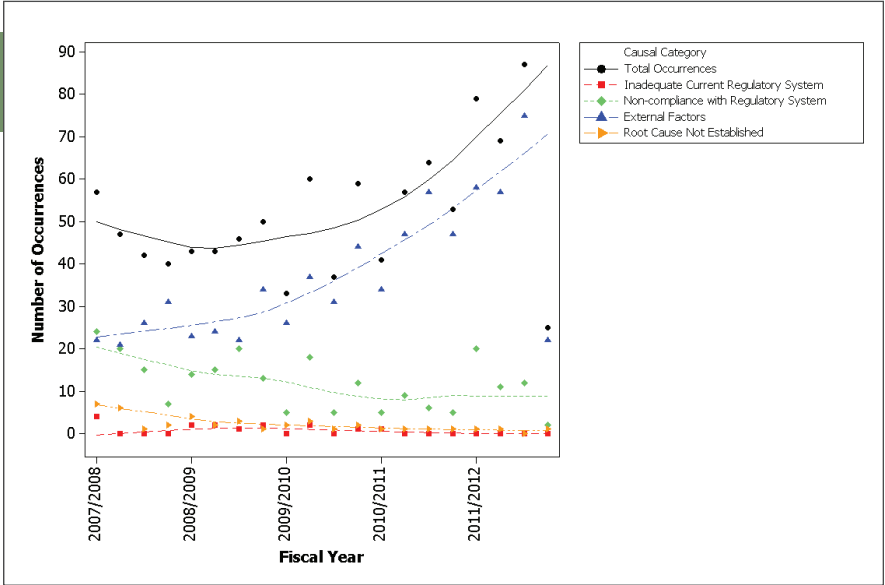


Figure ED-2 charts the number of fatalities, permanent injuries, and non-permanent injuries on elevators over the last five fiscal years. As illustrated, there have been three fatalities on elevators over the five-year period. An elevator-associated fatality occurred in fiscal year 2010/2011, for which the investigation was completed in the first quarter of fiscal year 2011/2012. An elderly woman tripped while entering an elevator, and hit her head on the back of the elevator car. A causal analysis was conducted, but a specific root cause could not be established.

A statistical analysis of the health impact data indicates that there are no significant trends in any of the injury categories.

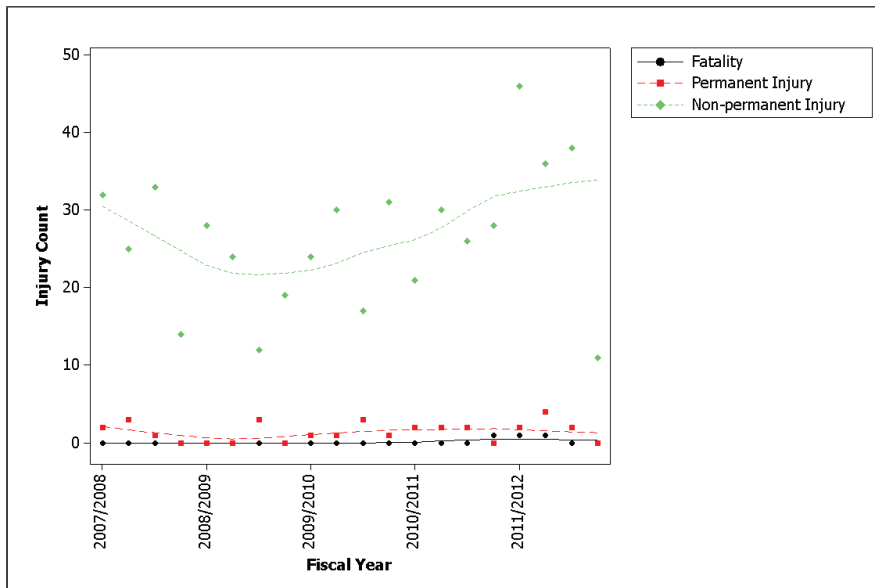


Figure ED-2: Fatalities, permanent injuries and non-permanent injuries involving elevators over the last five fiscal years.

A statistical analysis of the data indicates that the total number of DALYs associated with the injury counts does not demonstrate a significant trend over the measured period. This analysis also reveals that there are no significant trends for all causal categories.

Compliance Analysis

Periodic Inspections

There were 19,780 periodic inspections conducted in fiscal year 2011/2012. Each of these inspections resulted in an outcome as determined by a TSSA inspector, shown in Figure ED-3. Of all periodic inspections completed in fiscal year 2011/2012, 33.67% were compliant with regulations on the first visit.

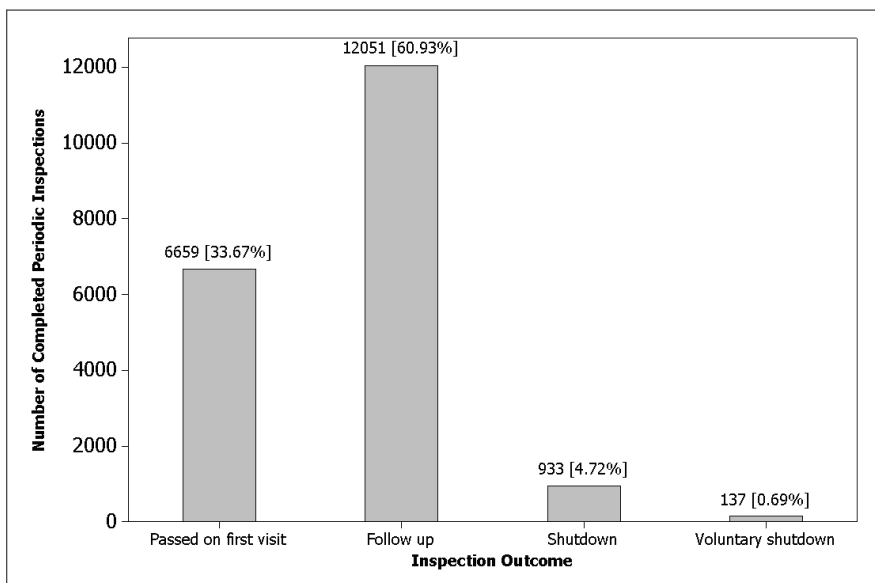


Figure ED-3: Outcomes from elevator periodic inspections completed in fiscal year 2011/2012.

TSSA inspectors issued a total of 43,982 inspection orders during the course of these periodic inspections. This yields an average number of inspection orders issued per inspection of 2.22.

A total of 23,839 inspection orders were resolved in fiscal year 2011/2012. These are made up of inspection orders issued during periodic inspections conducted in fiscal year 2009/2010 to fiscal year 2011/2012. The average time taken to resolve inspection orders during the fiscal year 2011/2012 was found to be 101 days. High-risk inspection orders constituted 0.86% of all inspection orders issued, while low-risk inspection orders constituted 62.76% of all inspection orders issued.

Compliance Related Trends

Figure ED-4 charts the number of periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that the number of periodic inspections does not demonstrate a significant trend over the period.

Figure ED-4: Periodic inspections completed on elevators over the last eight fiscal years.

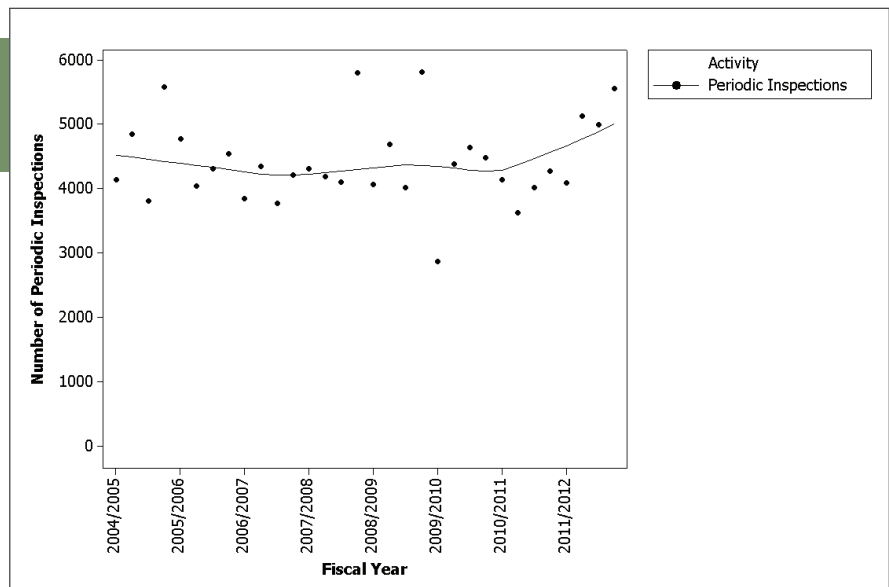


Figure ED-5 provides the average number of inspection orders per inspection for the last eight fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per inspection demonstrates a decreasing trend over the period at a rate of 0.01 orders per inspection per quarter.

Figure ED-5: The average number of inspection orders per periodic inspection on elevators over the last eight fiscal years.

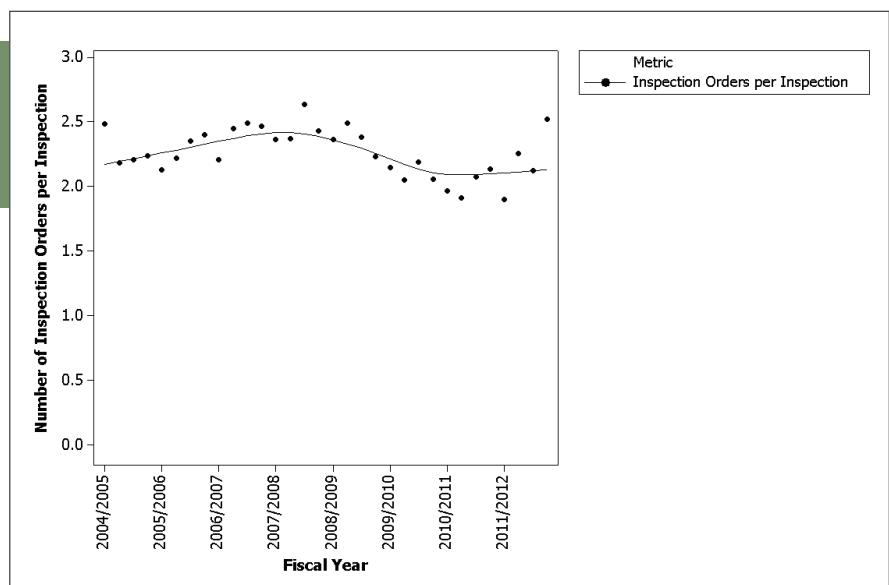


Figure ED-6 charts the outcomes from the periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that over the period there are increasing trends in the percentage of 'Passed on first visit' and 'Shutdown' inspection outcomes, at rates of 0.38% and 0.13% per quarter respectively. This analysis also reveals that over the measured period there is a decreasing trend in the percentage of 'Follow-up' inspection outcomes at a rate of 0.49% per quarter. The percentage of 'Voluntary Shutdown' inspection outcomes does not demonstrate a significant trend.

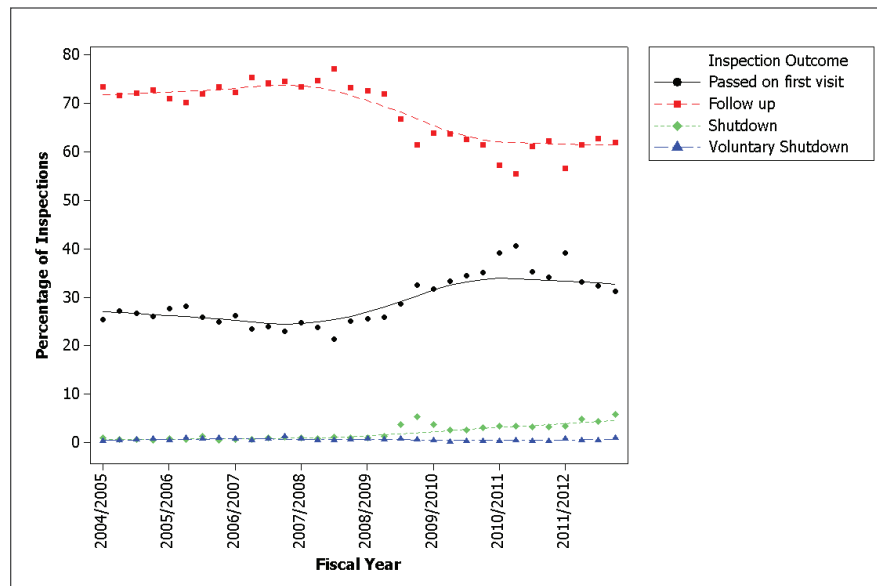


Figure ED-6: The inspection outcomes of periodic inspections completed on elevators over the last eight fiscal years.

Other Safety and Risk Analysis Results

The prediction intervals for the compliance outcomes for elevators, which represent the expected ranges of the indicator and are defined by the fifth and ninety-fifth percentiles of the trend data, are indicated in Table ED-3.

Table ED-3: Prediction intervals for compliance outcomes for elevators for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Periodic Inspections	Percentage Passed on First Visit	22.39%	39.71%
	Percentage Follow-up	56.25%	75.96%
	Percentage Shutdown	0.53%	5.55%
	Percentage Voluntary Shutdown	0.26%	1.13%
	Number of Orders per Inspection	1.91	2.56

The prediction intervals generated from the trend data for the safety outcomes for elevators are indicated in Table ED-4.

Table ED-4: Prediction intervals for safety outcomes for elevators for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Occurrences	Number of Fatalities	0	1
	Number of Permanent Injuries	0	4
	Number of Non-permanent Injuries	11	46

Predicted Health Impacts

The mean predicted health impact is 31.4 DALYs per million people per year or 0.7 fatality-equivalents per million people per year. The predicted fatality-equivalent is more than half of the risk acceptability criteria of 1 fatality-equivalent per million people per year with external factors, contributing to most of the predicted fatality-equivalent followed by non-compliance as seen in Figures ED-7 and ED-8. Also noteworthy is that health impacts due to non-compliance are expected to be nearly 23% of the total health impacts.

Figure ED-7: Predicted health impacts for elevators.

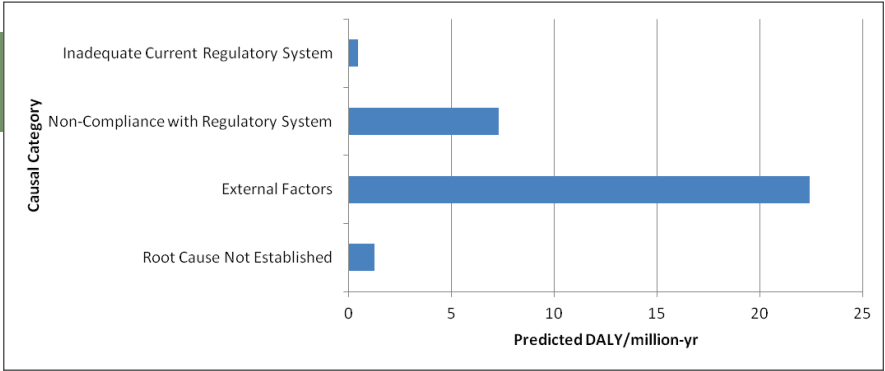
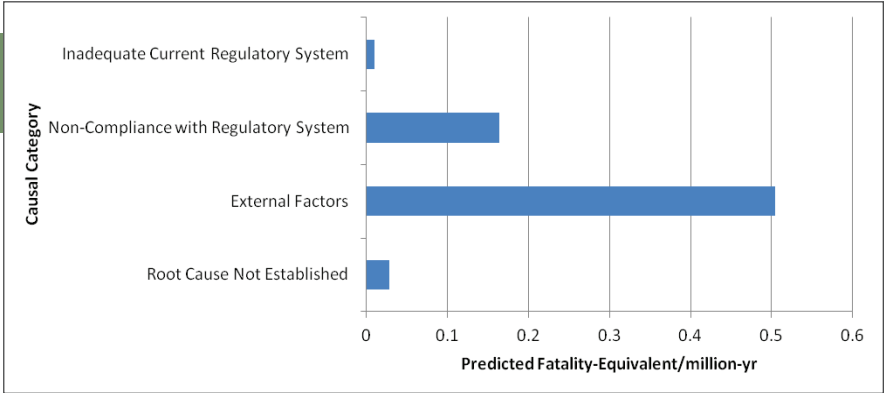


Figure ED-8: Predicted Fatality-Equivalent for elevators.



Risk Assessments

TSSA is currently undertaking a risk assessment of safety issues related to elevator overspeed and unintended movement. In particular, TSSA is interested in determining if there is a specific pattern to occurrences involving elevators with single or two-speed designs, and/or if there are concerns with unintended movement on older existing devices. A preliminary risk assessment of this issue determined an occurrence rate of 2.25 per million people per year as related to overspeeding and/or unintended movement of elevators. Additionally, the predicted health impact measured in terms of fatality-equivalents was determined to be 0.2 per million people per year.

TSSA is continuing to collect and analyze data including information through surveys from stakeholders to gain a better understanding of this issue. The risk assessment, which is expected to be completed by the end of the current fiscal year, will aid in making an informed decision in this regard.

Escalators and Moving Walks

TSSA regulates over 1,850 escalators and moving walks in Ontario to ensure all devices conform to the *Technical Standards and Safety Act, 2000* and applicable regulations, codes and standards. TSSA reviews and registers escalators and moving walks, issues licences, conducts inspections and performs incident investigations.

Analysis on State of Public Safety and Compliance

Occurrence Analysis

Table EM-1 summarizes the escalator and moving walk occurrences reported to TSSA for fiscal year 2011/2012 in accordance with the reporting guidelines provided to stakeholders. These occurrences can be categorized as an incident or a near-miss. The table includes their occurrence inspection status at the end of the fiscal year. The number of victims and their injury severity from the occurrences are also included. It should be noted that the reason that 452 occurrences did not require formal inspection is due to the fact that the occurrences were not deemed to be equipment-related. These are attributed to human factors that are outside the control or influence of TSSA and have been treated accordingly in the health impact analysis.

Table EM-1: Reported escalator and moving walk occurrences and health impacts.

Occurrence Detail	Number of Occurrences — May 1, 2011 – April 30, 2012
Number of Incidents	351
Number of Near-Misses	148
Occurrences Outside TSSA Jurisdiction	0
Total Reported Occurrences	499
Occurrences Deemed Within Jurisdiction	499
▪ Completed Causal Analysis	8
▪ Unable to Establish Root Cause	0
▪ In Progress	39
▪ Not Requiring Formal Inspection	452
Number of Fatalities	0
Number of Permanent Injuries	5
Number of Non-permanent Injuries	339

All of the permanent injuries occurred on escalators, and four were due to factors external to the regulatory system. A formal inspection has not yet been completed for the occurrence that led to the remaining permanent injury. The full causal categorization for the fiscal year is presented in Table EM-2. The categorization below applies to occurrences wherein an inspection has been completed or did not require a formal inspection.

Table EM-2: Causal categorization for occurrences on escalators and moving walks.

Causal Category	Number of Occurrences	Percentage of Occurrences	Health Impacts (DALYs)	Percentage of Total Health Impacts
1. Inadequate Current Regulatory System	0	0.00%	0.0000	0.00%
2. Non-compliance with Regulatory System	3	0.65%	0.0033	0.04%
3. External Factors	457	99.35%	7.6933	99.96%
4. Root cause not established	0	0.00%	0.0000	0.00%

Occurrence Related Trends

Figure EM-1 shows the number of occurrences to which TSSA has responded over the last five fiscal years and the associated causal categorization of these occurrences. A statistical analysis of this data indicates that the number of occurrences on escalators and moving walks does not demonstrate a significant trend over the period. This analysis also reveals that over the measured period there is a decreasing trend in the number of occurrences due to non-compliance with the regulatory system, at the rate of 0.42 occurrences per quarter. The primary contributor to the occurrences due to external factors continues to be 'failure to follow user instructions'.

Figure EM-1: Occurrences involving escalators and moving walks over the last five fiscal years.

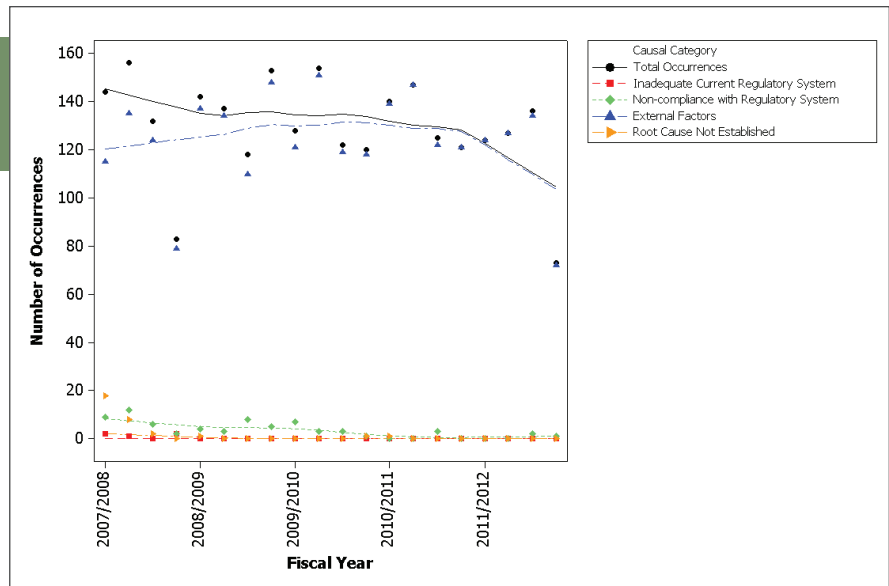
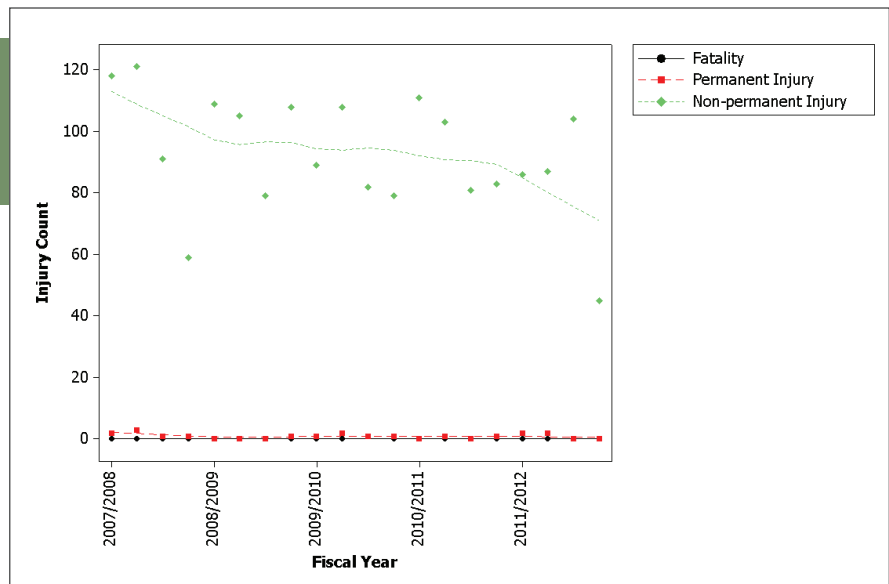


Figure EM-2 charts the number of fatalities, permanent injuries and non-permanent injuries on escalators and moving walks over the last eight fiscal years. As illustrated, there has been one escalator fatality within TSSA's jurisdiction in fiscal year 2009/2010. A statistical analysis of this data indicates that the number of permanent injuries and non-permanent injuries do not demonstrate a significant trend over the measured period.

Figure EM-2: Fatalities, permanent injuries, and non-permanent on escalators and moving walks over the last five fiscal years.



A statistical analysis of the data indicates that the total number of DALYs associated with the injury counts does not demonstrate a significant trend over the measured period. This analysis also reveals that there is a decreasing trend in the health impacts associated with occurrences due to non-compliance with the regulatory system, at a rate of 0.0009 DALYs per quarter. The other causal categories do not show a significant trend.

Compliance Analysis

Periodic Inspections

There were 821 periodic inspections conducted in fiscal year 2011/2012. Each of these inspections resulted in an outcome as determined by a TSSA inspector, shown in Figure EM-3. Of all periodic inspections completed in fiscal year 2011/2012, 18.64% were compliant with regulations on the first visit.

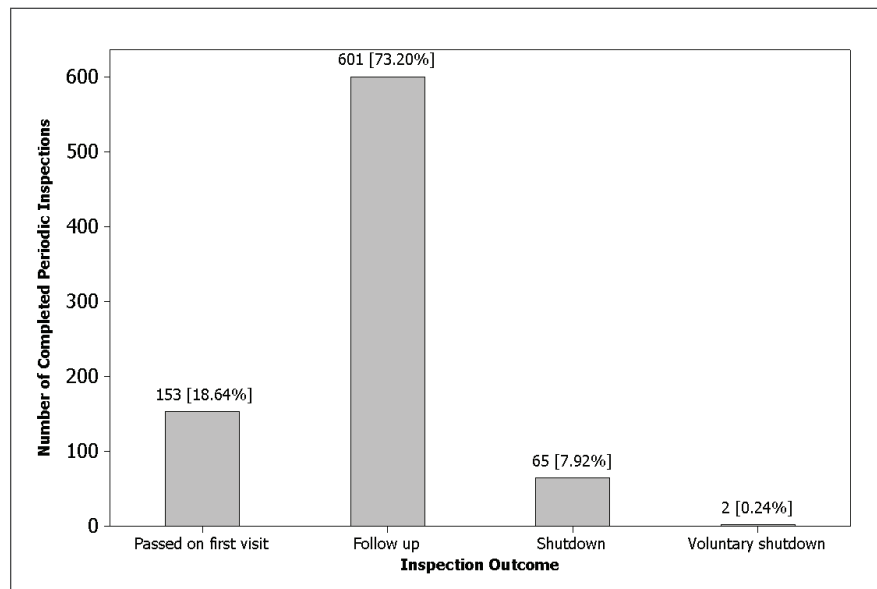


Figure EM-3: Outcomes from periodic inspections completed on escalators and moving walks in fiscal year 2011/2012.

TSSA inspectors issued a total of 2,647 inspection orders during the course of these periodic inspections. This yields an average number of inspection orders issued per inspection of 3.22.

A total of 1,320 inspection orders were resolved in fiscal year 2011/2012. These are made up of inspection orders issued during periodic inspections conducted in fiscal year 2009/2010 to fiscal year 2011/2012. Inspection orders took an average of 147 days to be resolved during this period. High-risk inspection orders constituted 6.06% of all orders issued. Low-risk inspection orders constituted 40.38% of all orders issued.

Compliance Related Trends

Figure EM-4 charts the number of periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that the number of periodic inspections does not demonstrate a significant trend over the period.

EM-4: Periodic inspections completed on escalators and moving walks over the last eight fiscal years.

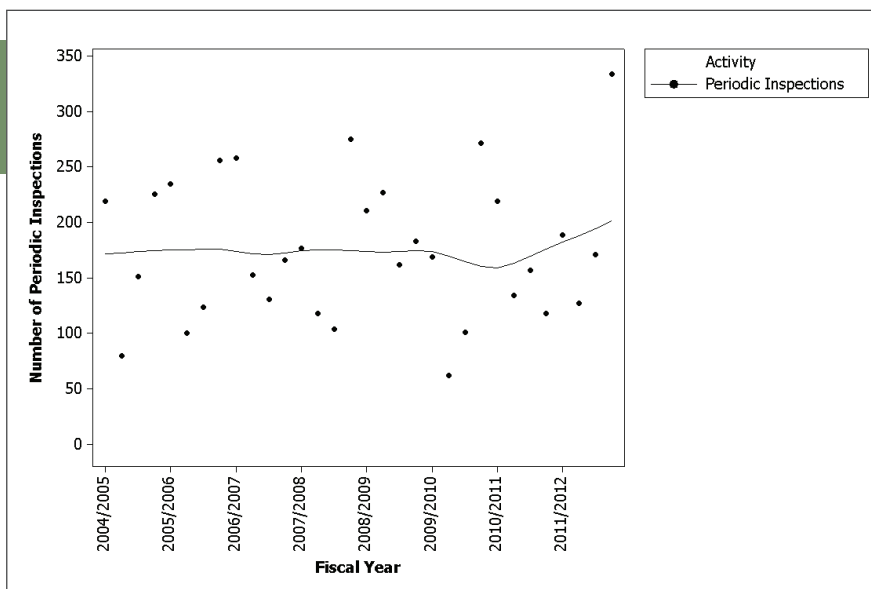


Figure EM-5 provides the average number of inspection orders per inspection for the last eight fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per inspection does not demonstrate a significant trend over the period.

Figure EM-5: The average number of inspection orders per periodic inspection on escalators and moving walks over the last eight fiscal years.

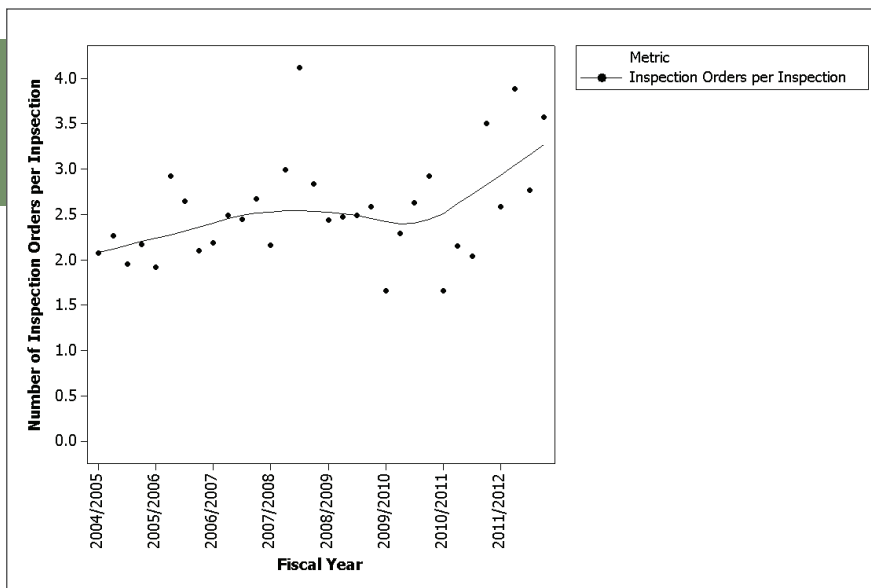


Figure EM-6 charts the outcomes from the periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that there is an increasing trend in the percentage of ‘Shutdown’ inspection outcomes over the period at rate of 0.19% per quarter. This analysis also reveals that there are no significant trends in any other inspection outcome.

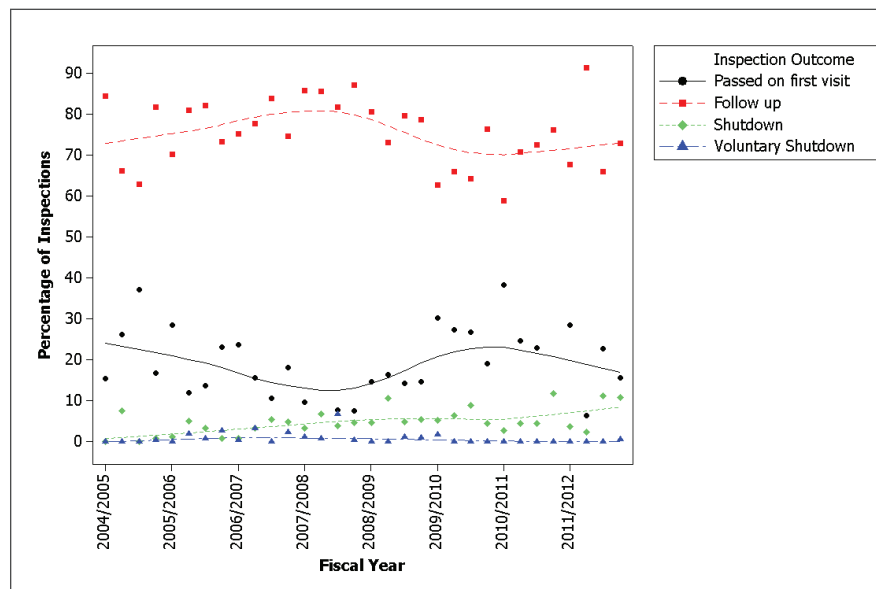


Figure EM-6: The inspection outcomes of periodic inspections completed on escalators and moving walks over the last eight fiscal years.

Other Safety and Risk Analysis Results

The prediction intervals for the compliance outcomes for escalators and moving walks, which represent the expected ranges of the indicator and are defined by the fifth and ninety-fifth percentiles of the trend data, are indicated in Table EM-3.

Table EM-3: Prediction intervals for compliance outcomes for escalators and moving walks for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Periodic Inspections	Percentage Passed on First Visit	6.61%	37.53%
	Percentage Follow-up	61.39%	88.70%
	Percentage Shutdown	0.00%	11.37%
	Percentage Voluntary Shutdown	0.00%	4.48%
	Number of Orders per Inspection	1.66	3.96

The prediction intervals generated from the trend data for the safety outcomes for escalators and moving walks are indicated in Table EM-4.

Table EM-4: Prediction intervals for safety outcomes for escalators and moving walks for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Occurrences	Number of Fatalities	0	1
	Number of Permanent Injuries	0	3
	Number of Non-permanent Injuries	46	121

Predicted Health Impacts

The mean predicted health impact for escalators and moving walks is 7 DALYs per million people per year or 0.2 fatality-equivalents per million people per year and is within the risk acceptability criteria. External factors like user behaviour are likely to be the leading cause of occurrences followed by non-compliances as shown in Figures EM-7 and EM-8.

Figure EM-7: Predicted health impacts for escalators and moving walks.

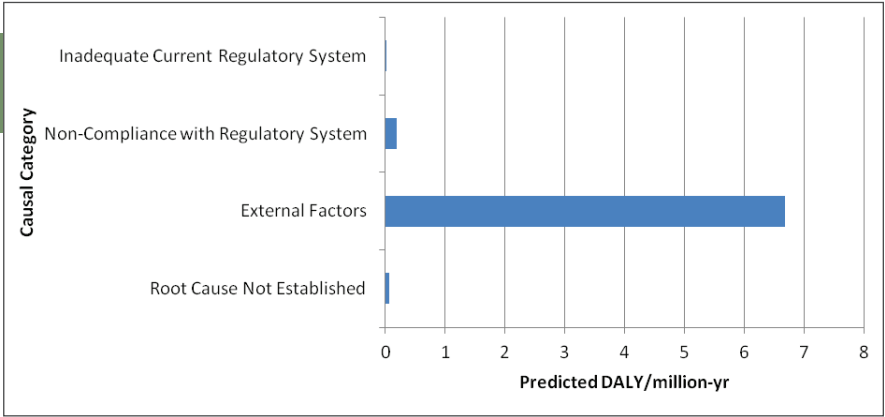
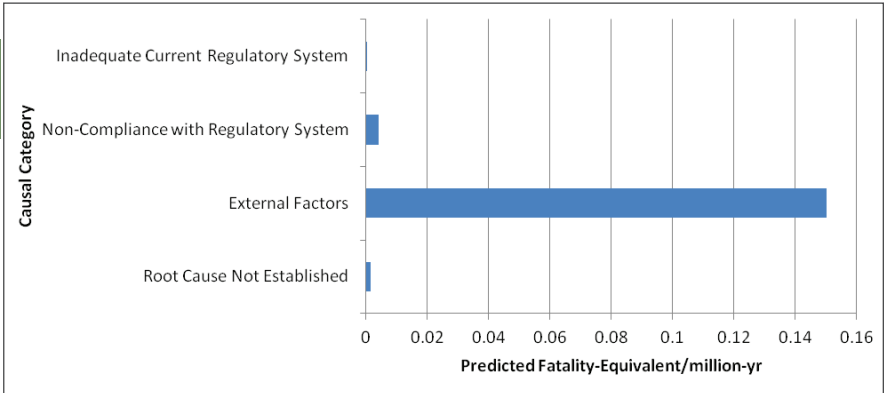


Figure EM-8: Predicted Fatality-Equivalent for escalators and moving walks.



Risk Assessments

TSSA has completed a risk assessment of safety issues related to escalator brakes, with the following results:

- an occurrence rate of three in five years is expected to occur with a predicted health impact of 8.25×10^{-5} DALYs per person per year;
- four categories of operational and maintenance related non-compliances found during past inspections continue to pose unacceptable levels of risk across the entire inventory of devices;
- 70% of the most significant non-compliances found relate to torque adjustment and stopping distance hazards; and
- the risk assessment study provides sufficient evidence to suggest that escalators pose unacceptable levels of risk due to continued inadequacies in the operation and maintenance of brakes.

In response, TSSA issued a Director’s Order that requires a check of the escalator brake as part of daily start up procedures. These additional requirements will ensure escalator brakes are functioning properly, and stopping the escalator within a prescribed distance. TSSA will monitor the effectiveness of this Director’s Order over the course of the next three years, and will report these results once sufficient data has been collected.

Ski Lifts

TSSA regulates chair lifts, bar lifts, outdoor recreational conveyors, rope tows and tube tows, totalling over 270 ski lifts in Ontario, to ensure all devices conform to the *Technical Standards and Safety Act, 2000* and applicable regulations, codes and standards. TSSA reviews and registers lift designs, conducts inspections and performs incident investigations. It also licenses lift devices, ensuring they conform to Ontario safety standards. TSSA in partnership with the Ontario Snow Resorts Association additionally provides public education throughout the province, promoting safer behaviour to ski lift users.

The trend analysis outlined in this section should be considered in the context that these devices are predominantly seasonal in nature. The trend analysis confirmed the seasonality and took it into account while establishing historical patterns of safety and compliance performance.

Analysis on State of Public Safety and Compliance

Occurrence Analysis

Table SL-1 summarizes the ski lift occurrences reported to TSSA for the fiscal year 2011/2012 in accordance with the reporting guidelines provided to stakeholders. These occurrences can be categorized as an incident or a near-miss. The table includes their occurrence inspection status at the end of the fiscal year. The number of victims and their injury severity from the occurrences are also included.

Occurrences not requiring formal inspections do not involve a device-related failure. These are attributed to human factors that are outside of the control or influence of TSSA and have been treated accordingly in the health impact analysis.

Table SL-1: Reported ski lift occurrences and health impacts.

Occurrence Detail	Number of Occurrences — May 1, 2011 – April 30, 2012
Number of Incidents	105
Number of Near-Misses	16
Occurrences Outside TSSA Jurisdiction	0
Total Reported Occurrences	121
Occurrences Deemed Within Jurisdiction	121
▪ Completed Causal Analysis	0
▪ Unable to Establish Root Cause	0
▪ In Progress	35
▪ Not Requiring Formal Inspection	86
Number of Fatalities	0
Number of Permanent Injuries	0
Number of Non-permanent Injuries	105

The full causal categorization for fiscal year is presented in Table SL-2. The categorization below applies to occurrences wherein an inspection has been completed or did not require a formal inspection.

Table SL-2: Causal categorization for occurrences on ski lifts.

Causal Category	Number of Occurrences	Percentage of Occurrences	Health Impacts (DALYs)	Percentage of Total Health Impacts
1. Inadequate Current Regulatory System	0	0.00%	0.0000	0.00%
2. Non-compliance with Regulatory System	0	0.00%	0.0000	0.00%
3. External Factors	86	100.00%	0.1414	100.00%
4. Root cause not established	0	0.00%	0.0000	0.00%

Occurrence Related Trends

Figure SL-1 shows the number of occurrences to which TSSA has responded over the last five fiscal years and the associated causal categorization of these occurrences. A statistical analysis of this data indicates that the number of occurrences on ski lifts does not demonstrate a significant trend over the period. This analysis also reveals that all the causal categories do not show significant trends. The primary contributor to the occurrences due to external factors continues to be 'failure to follow user instructions'.

Figure SL-1: Occurrences involving ski lifts over the last five fiscal years.

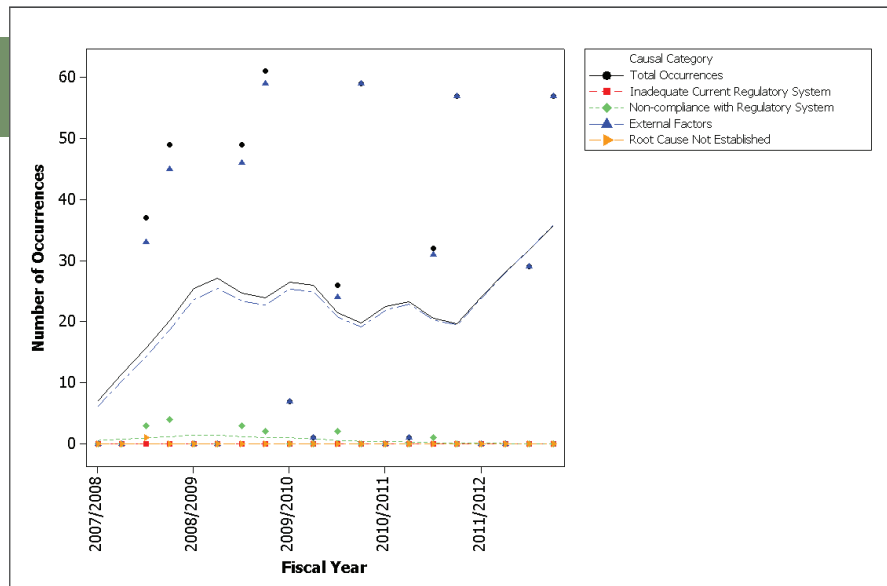


Figure SL-2 charts the number of fatalities, permanent injuries and non-permanent injuries on ski lifts over the last five fiscal years. As illustrated, there have been no fatalities on ski lifts within TSSA's jurisdiction during this period. A statistical analysis of this data indicates that the number of permanent injuries and non-permanent injuries do not demonstrate significant trends over the measured period.

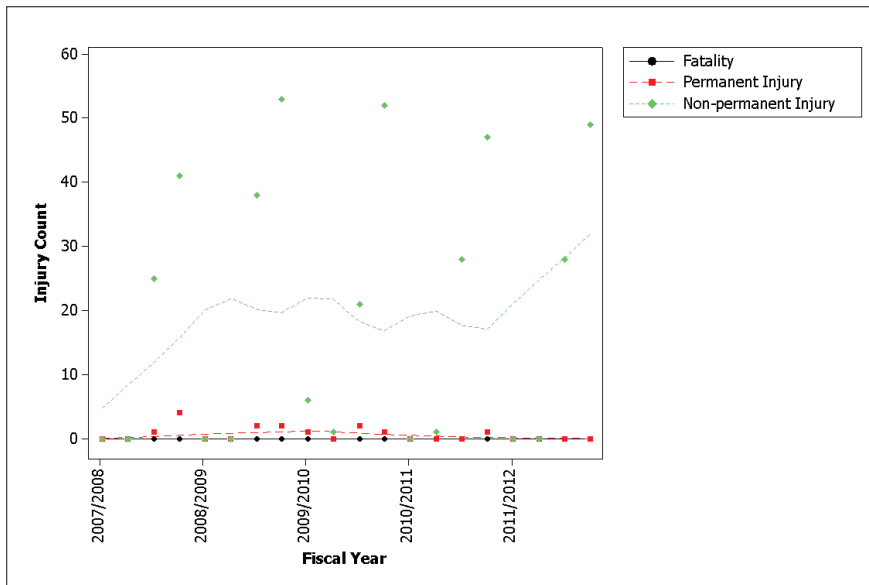


Figure SL-2: Fatalities, permanent injuries and non-permanent injuries on ski lifts over the last five fiscal years.

A statistical analysis of the data indicates that the total number of DALYs associated with the injury counts does not demonstrate a significant trend over the measured period. This analysis also reveals that there is no significant trend in the health impacts associated with any of the causal categories.

Compliance Analysis

Periodic Inspections

There were 116 periodic inspections conducted in fiscal year 2011/2012. Each of these inspections results in an outcome as determined by a TSSA inspector, shown in Figure SL-3. Of all periodic inspections completed in fiscal year 2011/2012, 44.83% were compliant with regulations on the first visit.

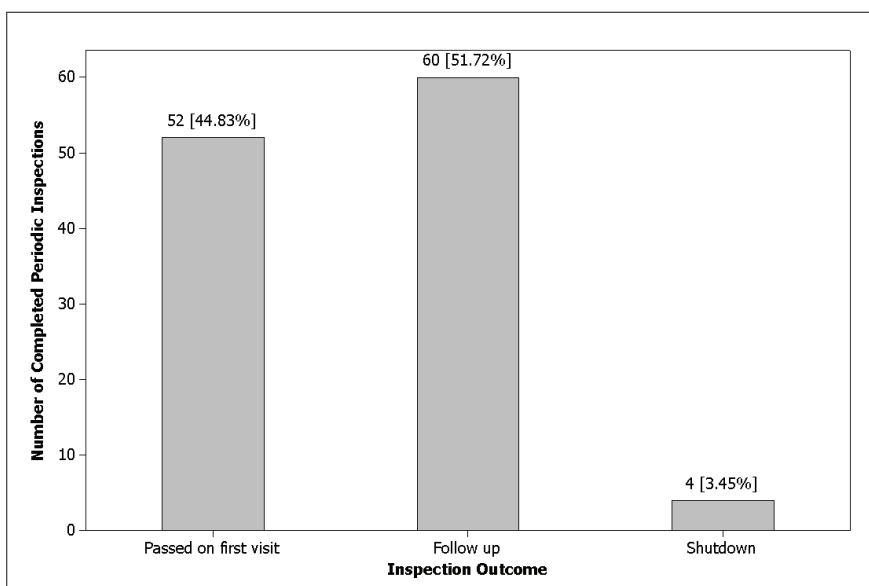


Figure SL-3: Outcomes from periodic inspections completed on ski lifts in fiscal year 2011/2012.

TSSA inspectors issued a total of 176 inspection orders during the course of these periodic inspections. This yields an average number of inspection orders issued per inspection of 1.52.

Compliance Related Trends

Figure SL-4 charts the number of periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that the number of periodic inspections does not demonstrate a significant trend over the period.

Figure SL-4: Periodic inspections completed on ski lifts over the last eight fiscal years.

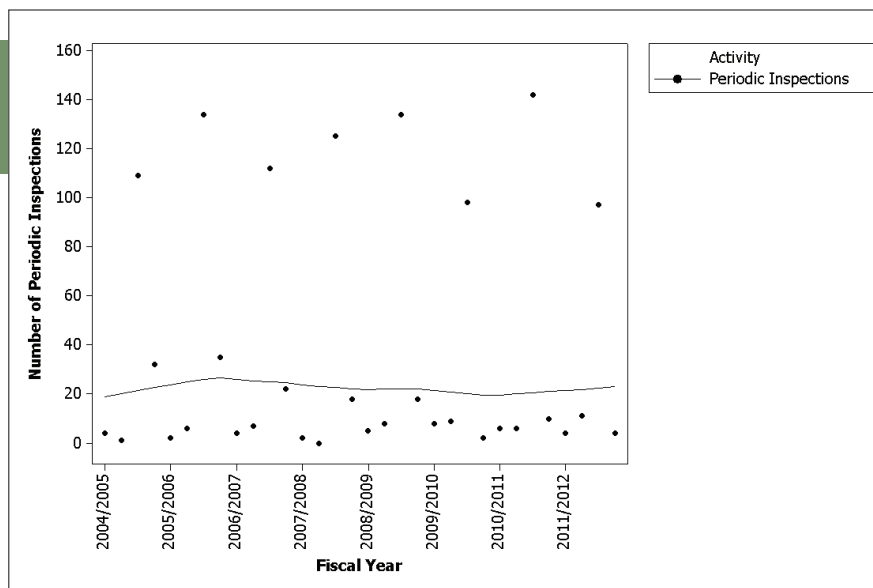


Figure SL-5 provides the average number of inspection orders per inspection for the last eight fiscal years. A statistical analysis of this data indicates that the average number of orders per inspection does not demonstrate a significant trend over the measured period.

Figure SL-5: The average number of inspection orders per periodic inspection on ski lifts over the last eight fiscal years.

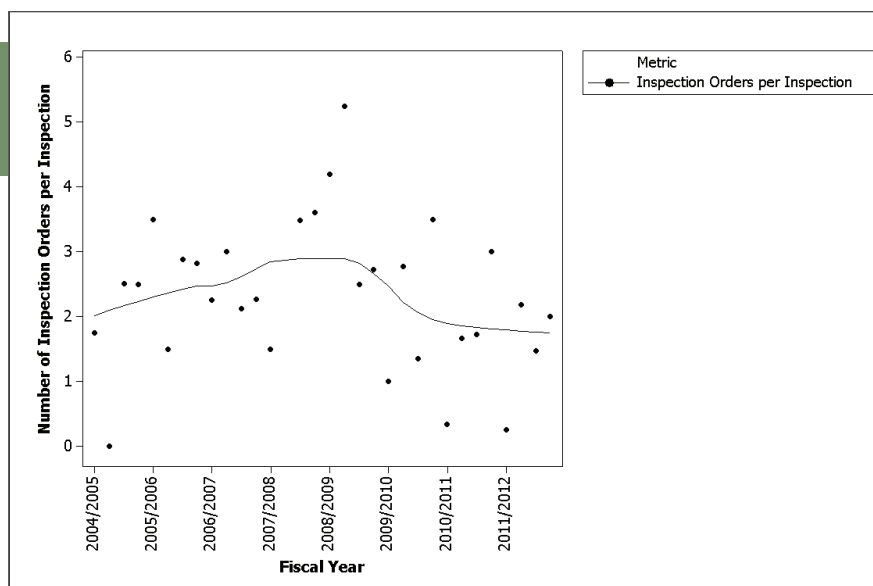


Figure SL-6 charts the outcomes from the periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that none of the inspection outcomes demonstrate a significant trend over the period.

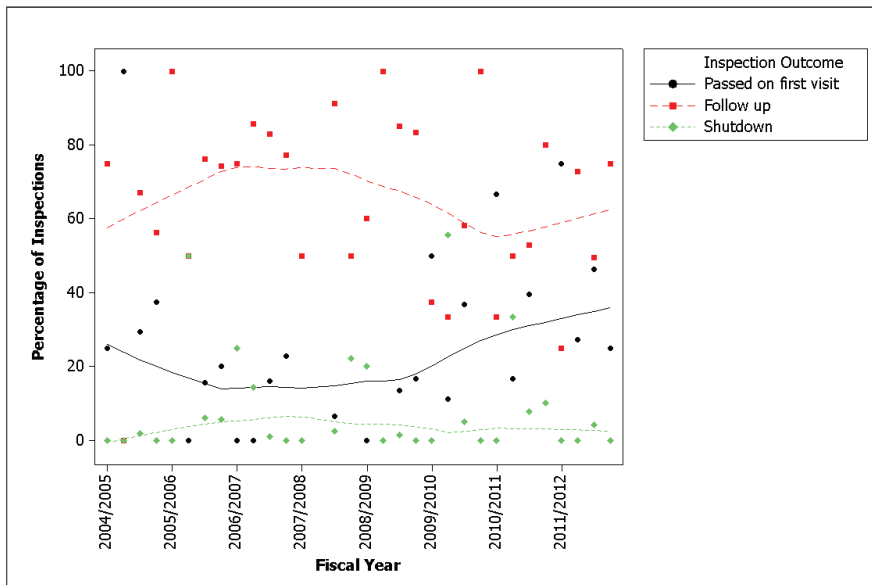


Figure SL-6: The percentage outcome in periodic inspections completed on ski lifts over the last eight fiscal years.

Other Safety and Risk Analysis Results

Due to the seasonality of inspections, prediction intervals for compliance outcomes on ski lifts are not able to be calculated at this time. A minimum of ten years of data is required to produce statistically significant intervals.

The prediction intervals for the safety outcomes for ski lifts, which represent the expected ranges of the indicator and are defined by the fifth and ninety-fifth percentiles of the trend data, are indicated in Table SL-3.

Table SL-3: Prediction intervals for safety outcomes for ski lifts for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Occurrences	Number of Fatalities	0	0
	Number of Permanent Injuries	0	4
	Number of Non-permanent Injuries	0	53

Predicted Health Impacts

The mean predicted health impact is 1.3 DALYs per million people per year or 0.03 fatality-equivalents per million people per year and is well within the risk acceptability criteria. Predictions indicate that external factors and non-compliance with the regulatory system are expected to be contributing causes for future occurrences as illustrated in Figures SL-7 and SL-8.

Figure SL-7: Predicted Health Impacts for ski lifts.

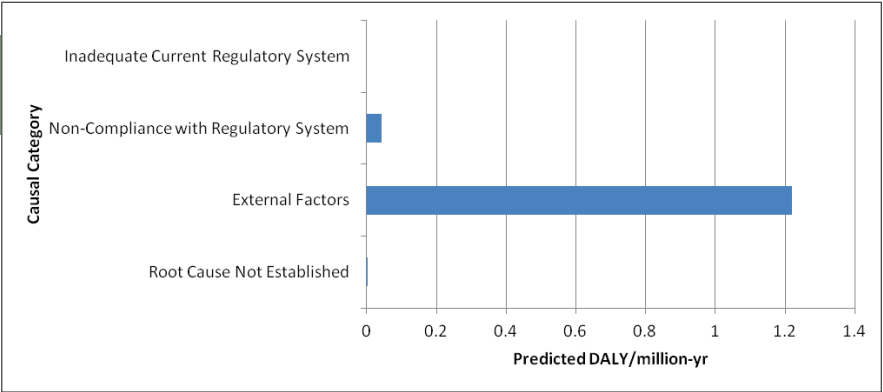
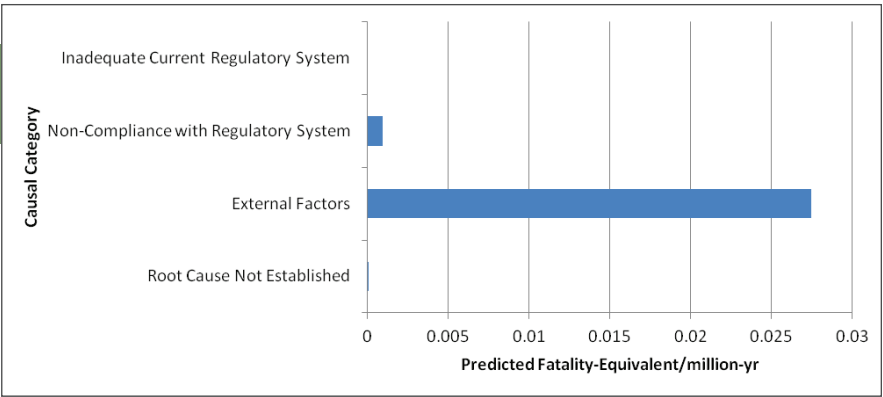


Figure SL-8: Predicted Fatality-Equivalent for ski lifts.



Fuels

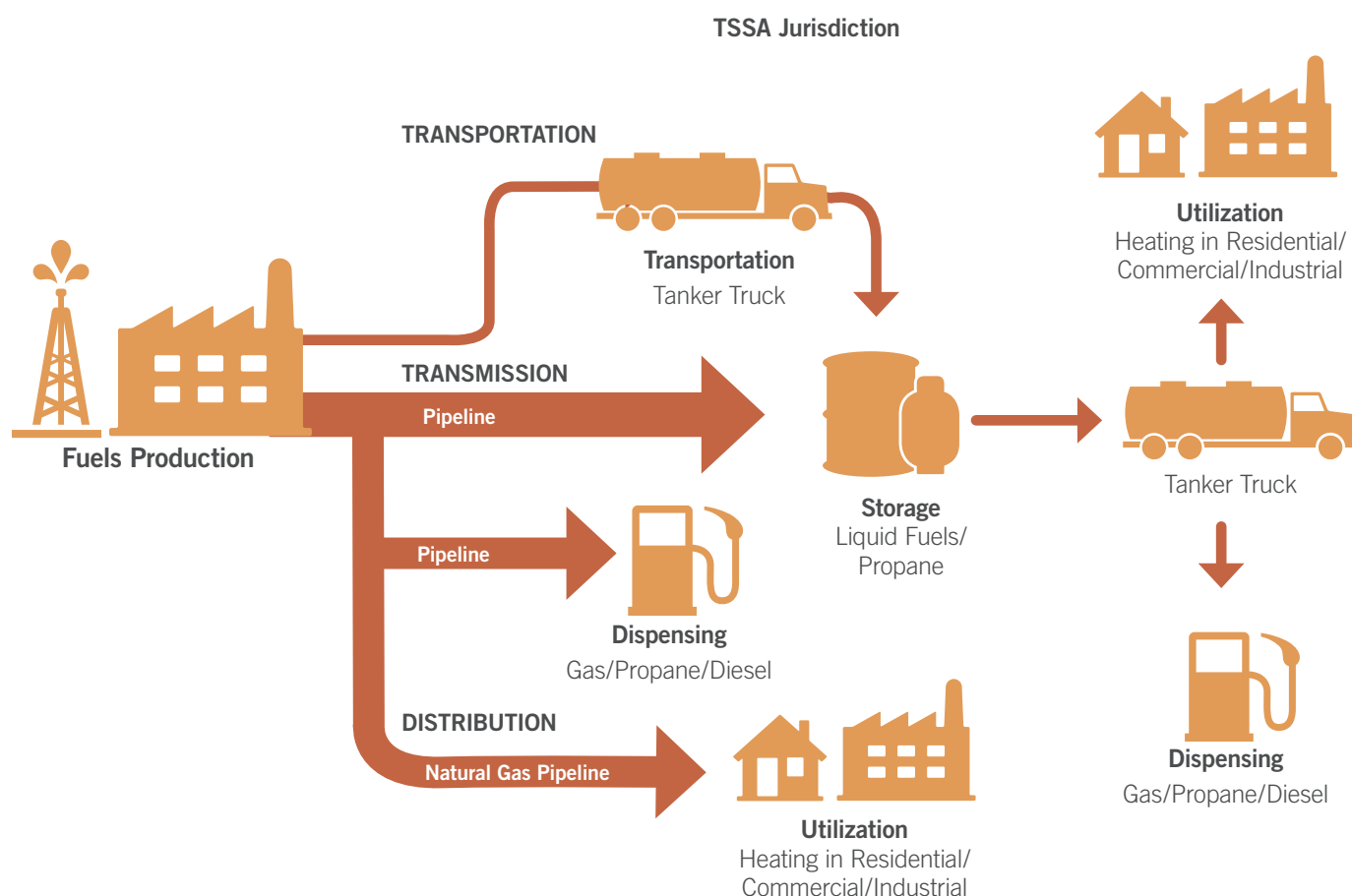
TSSA regulates the transportation, storage, handling and use of fuels as to ensure conformance to the *Technical Standards and Safety Act, 2000* and applicable regulations, codes and standards. These fuels include natural gas, propane, butane, hydrogen, digester gas, landfill gas, fuel oil, gasoline and diesel. TSSA licenses fuel facilities, registers contractors and certifies tradespersons who install and service equipment.

Additionally, TSSA reviews and approves facility plans for sites licensed by TSSA, and performs custom equipment approvals and inspection services to ensure fuel is handled and used safely.

The three stages of the fuels life cycle that fall under TSSA's jurisdiction as illustrated in Figure FS-1 are:

- transmission, distribution and transportation;
- storage and dispensing; and
- utilization (burning).

Figure FS-1: The fuels life cycle



Analysis on State of Public Safety and Compliance

Occurrence Analysis

TSSA's occurrence information tracking database, the Incident Management Information System (IMIS), categorizes each type of occurrence reported to TSSA. Table FS-1 provides a summary of the occurrences by type reported to the TSSA during fiscal year 2011/2012. These occurrences include those that are currently in progress and those with resolved root cause analysis. The health impact associated with each occurrence type is also included in the table below.

Table FS-1: Fuels occurrence types and health impacts for fiscal year 2011/2012.

Occurrence Type	Number of Occurrences	Number of Fatalities	Number of Permanent Injuries	Number of Non-permanent Injuries
Carbon Monoxide Release	279	0	0	28
Discovery of a Petroleum Product	65	0	0	0
Explosion	34	1	2	1
Fire	183	0	4	0
Leak	224	0	0	0
Liquid Petroleum Spill	77	0	0	0
Other	58	0	1	0
Pipeline Strike	2434	0	0	0
Unknown	4	0	0	0
Vapour Release	215	1	2	0
Total Occurrences	3573	2	9	29

Due to the distinct nature of pipeline strike occurrences, their status is presented separately from the other types of occurrences. Hereafter, any references to occurrences assume that pipeline strikes have been excluded. Table FS-2 presents the number of pipeline strikes that were reported to TSSA in accordance with the reporting guidelines provided to stakeholders. Each occurrence is categorized as an incident or a near-miss. The table includes their occurrence inspection status at the end of the fiscal year. Finally, the number of pipeline strikes reported to the TSSA but are outside of its jurisdiction is also included; these pipeline strikes are not included in any of the analysis or trending.

Table FS-2: Reported pipeline strikes and health impacts.

Occurrence Detail	Number of Occurrences — May 1, 2011 – April 30, 2012
Number of Incidents	2421
Number of Near-Misses	13
Occurrences Outside TSSA Jurisdiction	191
Total Reported Occurrences	2625
Occurrences deemed within jurisdiction	2434
▪ Completed Causal Analysis	1540 ¹⁵
▪ Unable to Establish Root Cause	0
▪ In Progress	635
▪ Not Requiring Formal Inspection	259
Number of Fatalities	0
Number of Permanent Injuries	0
Number of Non-permanent Injuries	0

¹⁵ 62 of these occurrence inspections were documented after May 1, 2012

Table FS-3 lists the damage reasons associated with pipeline strikes for inspections completed in the fiscal year 2011/2012. The most significant damage reason was 'Excavation practices not sufficient'.

Table FS-3: Distribution of causes for pipeline strike inspections completed in fiscal year 2011/2012.

Damage Reason	Number of Pipeline Strikes — May 1, 2011 – April 30, 2012
Abandoned facility	2
Deliberate damage	1
Deteriorated facility	11
Excavation practices not sufficient	894
Facility could not be found or located	6
Facility marking or location not sufficient	66
Facility was not located or marked	103
Incorrect facility records/maps	31
No notification made to Ontario One Call Centre	283
Notification to Ontario One Call made but not sufficient	3
Ontario One Call notification error	0
Other	59
Previous damage	6
Undetermined	3
Wrong information provided	4
Total	1472

Table FS-4 summarizes the fuels occurrences reported to TSSA in accordance with the reporting guidelines provided to stakeholders. These occurrences can be categorized as an incident or a near-miss. The table includes their occurrence inspection status at the end of the fiscal year. Finally, the number of occurrences reported to the TSSA but which are outside of its jurisdiction are also included; these occurrences are not included in any of the analysis or trending.

Table FS-4: Reported fuels occurrences and health impacts.

Occurrence Detail	Number of Occurrences — May 1, 2011 – April 30, 2012
Number of Incidents	1080
Number of Near-Misses	59
Occurrences Outside TSSA Jurisdiction	416
Total Reported Occurrences	1555
Occurrences deemed within jurisdiction	1139
▪ Completed Causal Analysis	469
▪ Unable to Establish Root Cause	0
▪ In Progress	664
▪ Not Requiring Formal Inspection	6
Number of Fatalities	2
Number of Permanent Injuries	9
Number of Non-permanent Injuries	29

Table FS-5 shows the fuel types involved in fuels occurrences.

Table FS-5: Reported fuels occurrences by fuel type

Fuel Type	Number of Occurrences
Butane	0
Diesel	26
Fuel oil	171
Gasoline	35
Hydrogen	0
Natural gas	325
Other Hydrocarbon Fuel	2
Propane	34
Used oil	1
Fuel Type Not Confirmed	545
TOTAL	1139

The full causal categorization for fiscal year is presented in Table F-6. The categorization below is made for fuels occurrences whose inspection has been completed. Please note, all pipeline strikes are assumed to be due to non-compliance with the regulatory system.

Table FS-6: Causal categorization for fuels occurrences.

Causal Category	Number of Occurrences	Percentage of Occurrences	Health Impacts (DALYs)	Percentage of Total Health Impacts
1. Inadequate Current Regulatory System	3	0.64%	0.0000	0.00%
2. Non-compliance with Regulatory System	375	79.96%	31.9738	33.27%
3. External Factors	90	19.19%	64.1344	66.73%
Root Cause Not Established	1	0.21%	0.0000	0.00%

Occurrence Related Trends

Figure FS-2 shows the number of pipeline strikes to which TSSA has responded over the last five-and-a-half fiscal years. A statistical analysis indicates that this number does not demonstrate a significant trend over the period. Since the introduction of an enhanced pipeline strike inspection documentation process in fiscal year 2011/2012, specific reasons for pipeline strikes can be analyzed and addressed. For the time during which this process has been in place, analysis indicates that 60.73% of strikes are due to improper excavation practices.

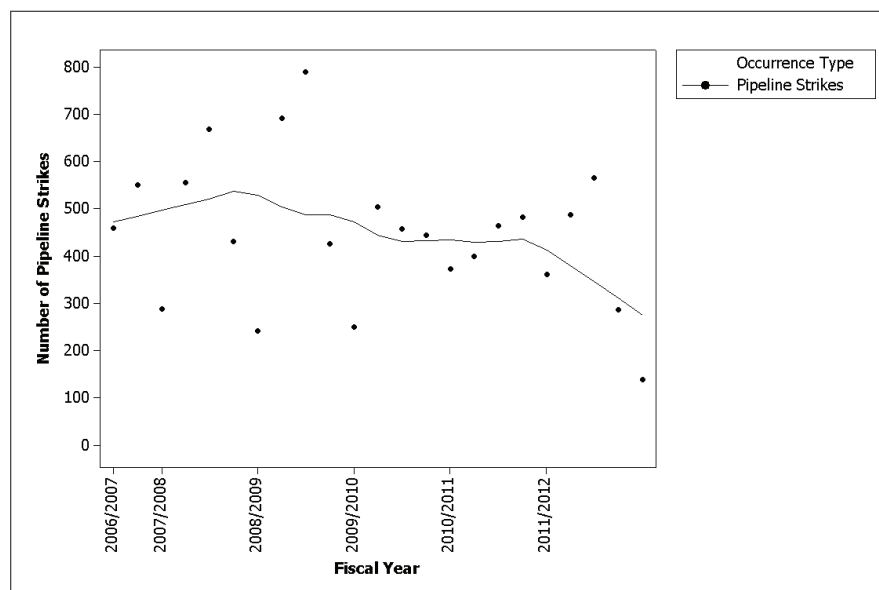


Figure FS-2: Number of pipeline strikes over the last five-and-a-half fiscal years.

Figure FS-3 shows the number of occurrences to which TSSA has responded over the last five-and-a-half fiscal years by occurrence type. A statistical analysis reveals decreasing trends in all occurrence types over the period except for the 'discovery of a petroleum product' and occurrences where the fuel type was not known or recorded.

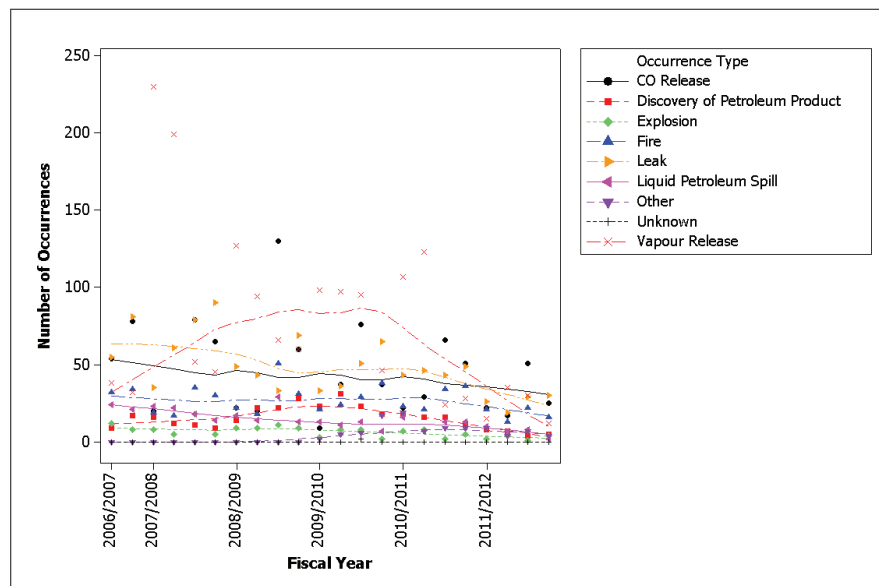


Figure FS-3: Occurrences by occurrence type over the last five-and-a-half fiscal years.

Figure FS-4 shows the percentage distribution of occurrences across the fuels life cycle over the last five-and-a-half fiscal years. A statistical analysis of this data indicates that over the period there is an increasing trend in the percentage of occurrences in the utilization life cycle stage, at a rate of 0.73% per quarter respectively. All other life cycle stages do not demonstrate significant trends.

Figure FS-4: The percentage of occurrences by life cycle stage over the last five-and-a-half fiscal years.

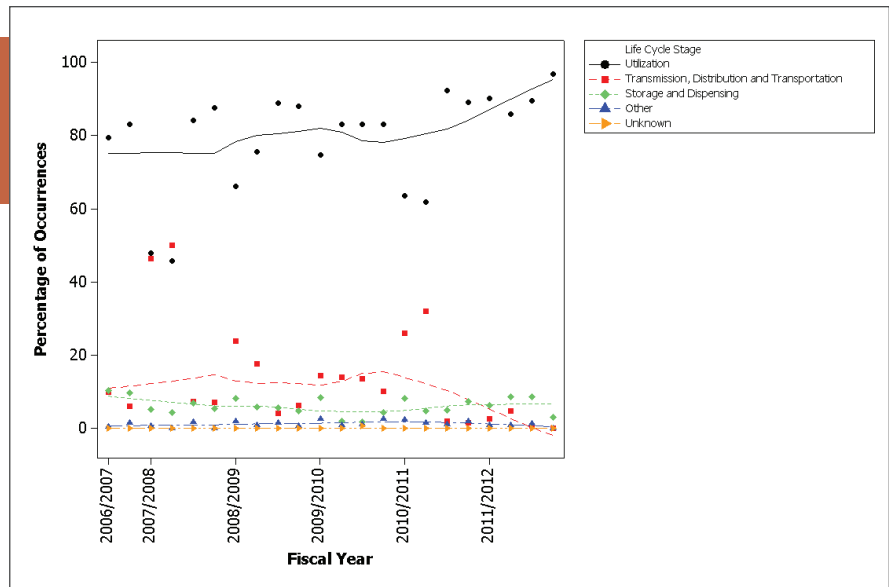


Figure FS-5 charts the number of fatalities, permanent injuries and non-permanent injuries over the last five-and-a-half fiscal years. A statistical analysis of this data indicates that the number of permanent injuries exhibits a decreasing trend over the period, at a rate of 0.50 occurrences per quarter. The number of fatalities and non-permanent injuries do not demonstrate significant trends over the period.

Figure FS-5: Fuels fatalities, permanent injuries and non-permanent injuries over the last five-and-a-half fiscal years.

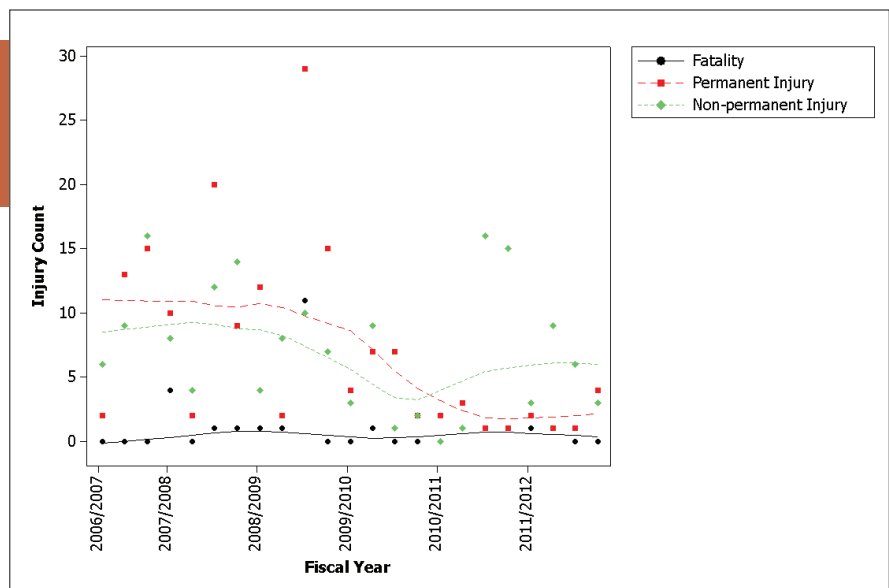


Figure FS-6 shows the number of occurrences to which TSSA has responded over the last five-and-a-half fiscal years and the associated causal categorization of these occurrences. A statistical analysis of this data indicates that the total number of occurrences involving fuels demonstrates a decreasing trend over the period at a rate of 8.6 occurrences per quarter. This analysis also reveals all three causal categories exhibit decreasing trends over the measured period. The number of occurrences with root cause not established does not show a significant trend.

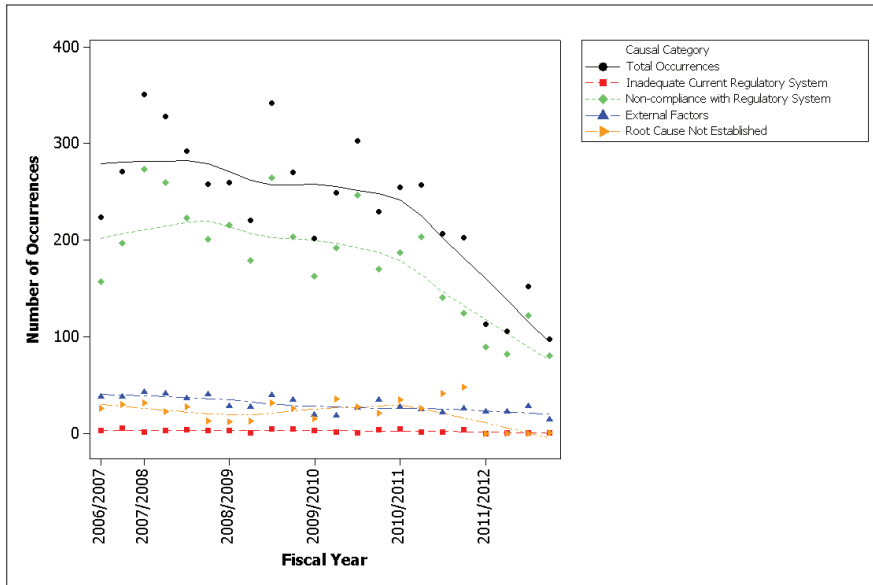


Figure FS-6: Occurrences involving fuels and the causal category over the last five-and-a-half fiscal years.

A statistical analysis of the data indicates that the total number of DALYs associated with the injury counts does not demonstrate a significant trend over the measured period. This analysis also reveals that there is no significant trend in the health impacts associated with any of the causal categories.

Compliance Analysis

Periodic Inspections

There were 3,102 periodic inspections conducted in fiscal year 2011/2012. Each of these inspections resulted in an outcome as determined by a TSSA inspector, shown in Figure FS-7. Of all periodic inspections completed in fiscal year 2011/2012, 56.16% were compliant with regulations on the first visit.

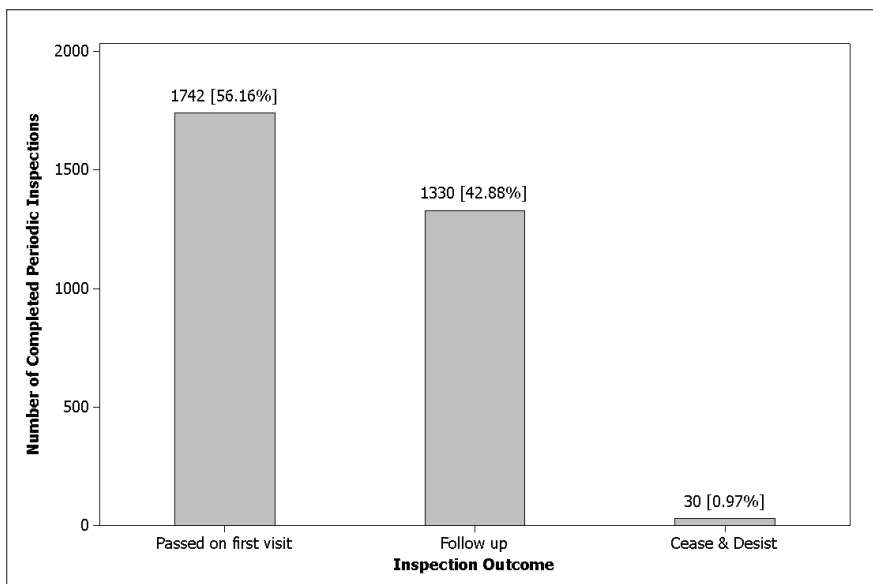


Figure FS-7: Outcomes from fuels periodic inspections completed in fiscal year 2011/2012.

TSSA inspectors issued a total of 5,071 inspection orders during the course of these periodic inspections. This yields an average number of inspection orders issued per inspection of 1.63.

Compliance Related Trends

Figure FS-8 charts the number of periodic inspections over the last eight fiscal years. A statistical analysis of this data indicates that the number of periodic inspections demonstrates an increasing trend at a rate of 9.03 inspections per quarter.

Figure FS-8: Fuels periodic inspections completed over the last eight fiscal years.

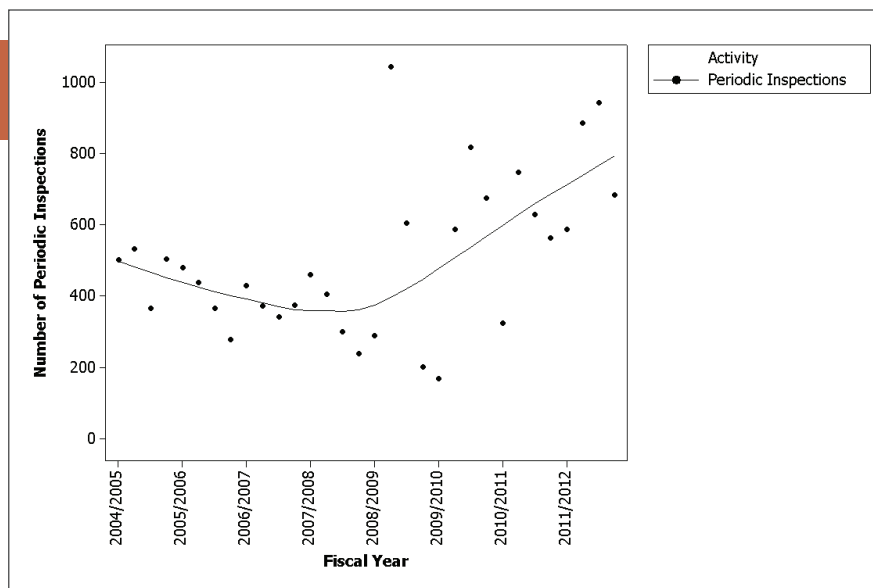


Figure FS-9 provides the average number of inspection orders per inspection for the last eight fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per inspection exhibits a decreasing trend over the period at a rate of 0.03 inspection orders per inspection per quarter.

Figure FS-9: The number of inspection orders per fuels periodic inspection over the last eight fiscal years.

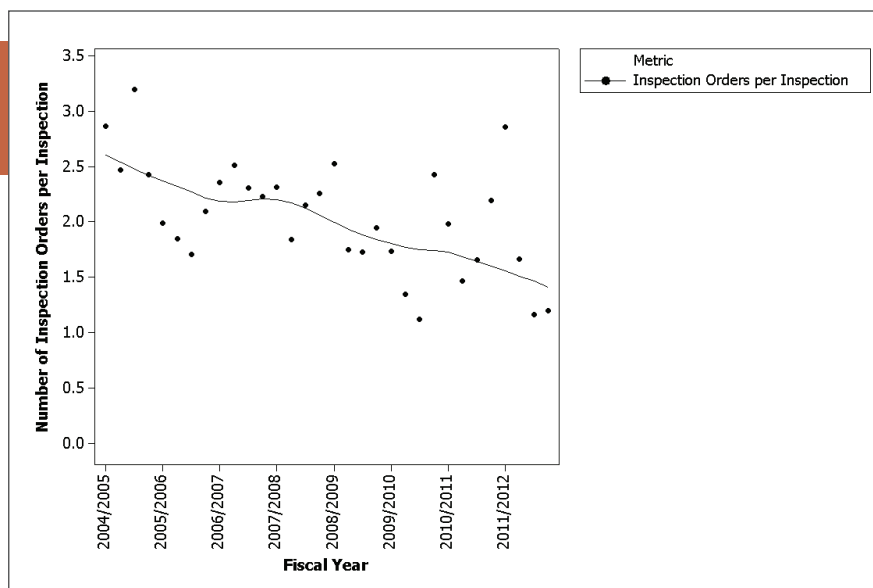


Figure FS-10 charts the outcomes from fuels periodic inspections completed over the last eight fiscal years. A statistical analysis of this data indicates that over the period there are increasing trends in the percentage of 'Passed on first visit' and 'Cease & Desist' inspection outcomes, at a rate of 0.59% and 0.03% respectively. This analysis also reveals that there is a decreasing trend in the percentage of 'Follow-up' inspection outcomes at a rate of 0.65% per quarter.

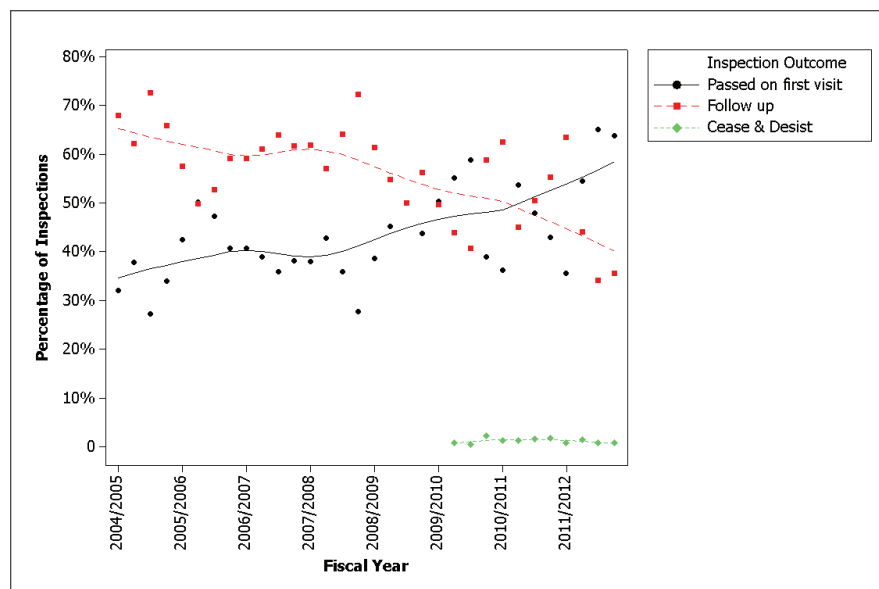


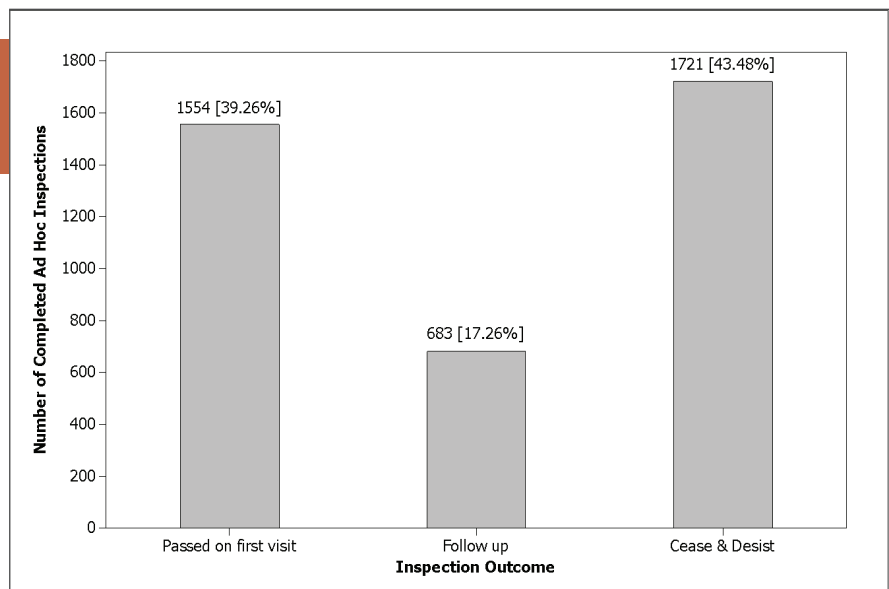
Figure FS-10: Fuels periodic inspection outcomes by percentage over the last eight fiscal years.

Ad Hoc Inspections

Due to the broad scope of TSSA's authority with respect to the fuels sector, Fuels inspectors conduct many inspections at sites and on persons who have not been authorized by TSSA. Examples include construction sites, residences, campsites, and private petroleum sites. Additionally, inspectors conduct unscheduled inspections at sites and on persons who have been authorized by TSSA. The described inspection work is categorized as ad hoc inspections.

There were 3,958 ad hoc inspections conducted in fiscal year 2011/2012. Each of these inspections resulted in an outcome as determined by a TSSA inspector, shown in Figure FS-11. Of all ad hoc inspections completed in fiscal year 2011/2012, 39.26% were compliant with regulations on the first visit.

Figure FS-11: Outcomes from fuels ad hoc inspections completed in fiscal year 2011/2012.



TSSA inspectors issued a total of 7,863 inspection orders during the course of these ad hoc inspections. This yields an average number of inspection orders issued per inspection of 1.99.

Compliance Related Trends

Figure FS-12 charts the number of ad hoc inspections over the last eight fiscal years. A statistical analysis of this data indicates that the number of ad hoc inspections do not demonstrate a significant trend over the period.

Figure FS-12: Fuels ad hoc inspections completed over the last eight fiscal years.

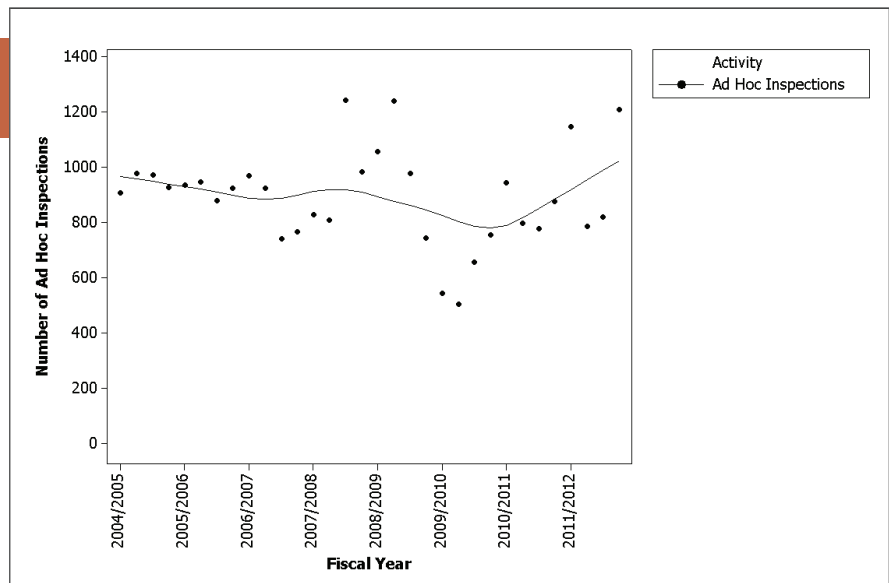


Figure FS-13 provides the average number of inspection orders per inspection for the last eight fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per inspection demonstrates an increasing trend over the period, at a rate of 0.01 inspection orders per inspection per quarter.

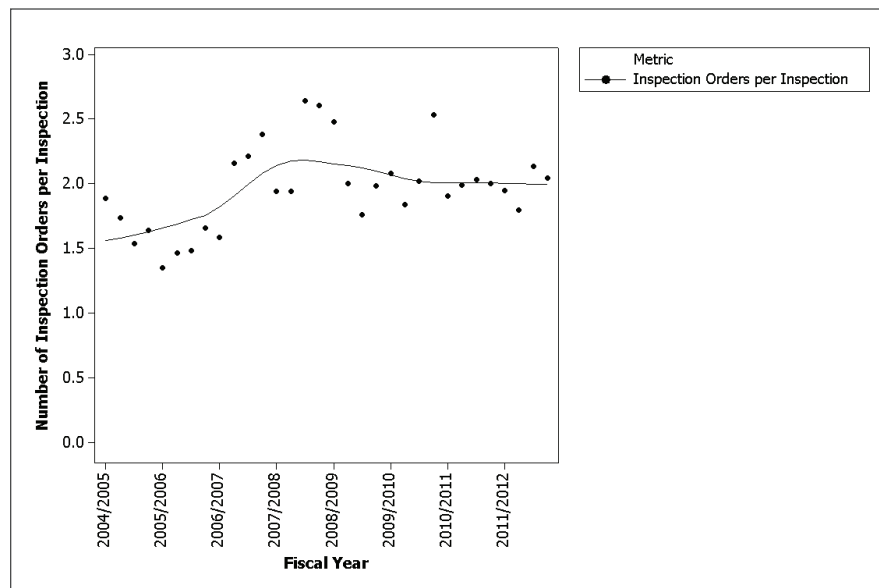


Figure FS-13: The number of inspection orders per fuels ad hoc inspection over the last eight fiscal years.

Figure FS-14 charts the outcomes from fuels ad hoc inspections completed over the last eight fiscal years. A statistical analysis of this data indicates that there is an increasing trend in the percentage of 'Cease & Desist' inspection outcomes over the period at a rate of 1.31% per quarter. This analysis also reveals a decreasing trend in the percentage of 'Follow-up' inspection outcomes over the measured period at a rate of 1.46%. The percentage of 'Passed on first visit' inspection outcomes does not demonstrate a significant trend.

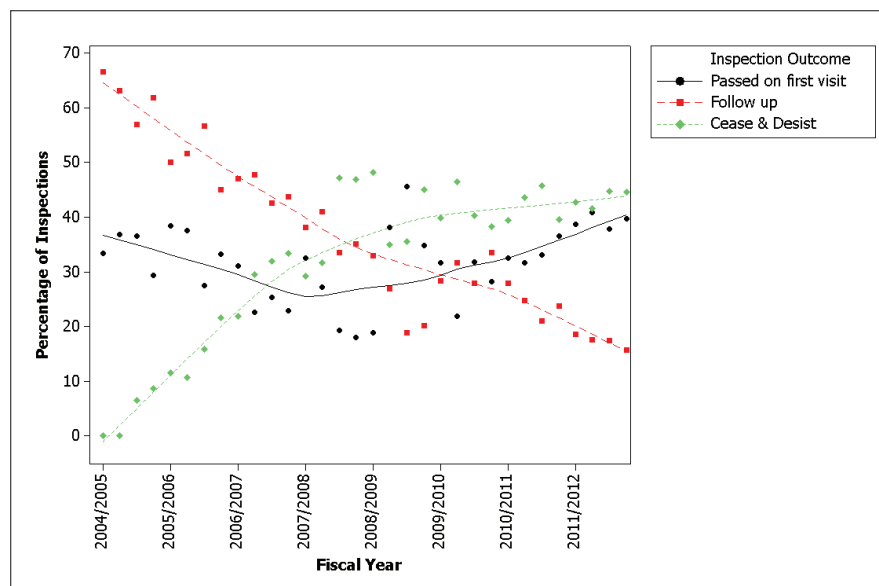
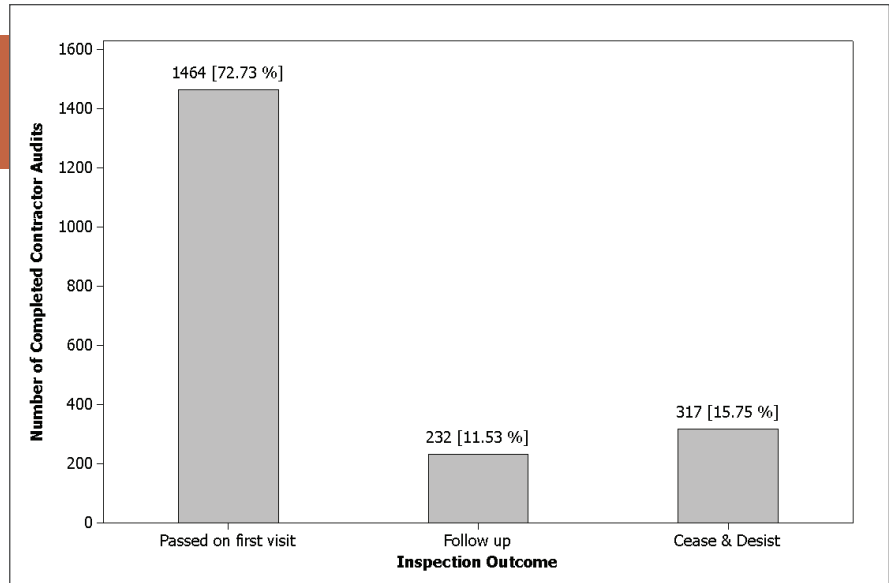


Figure FS-14: Fuels ad hoc inspection outcomes by percentage over the last eight fiscal years.

Contractor Audits

There were 2,013 contractor audits conducted in fiscal year 2011/2012. Each of these audits resulted in an outcome as determined by a TSSA inspector, shown in Figure FS-15. Of all contractor audits completed in fiscal year 2011/2012, 72.73% were compliant with regulations on the first visit.

Figure FS-15: Outcomes from fuels contractor audits completed in fiscal year 2011/2012.



TSSA inspectors issued a total of 3,409 inspection orders during the course of these audits. This yields an average number of inspection orders issued per audit of 1.69.

Compliance Related Trends

Figure FS-16 charts the number of contractor audits over the last eight fiscal years. A statistical analysis of this data indicates that the number of contractor audits does not demonstrate a significant trend over the period.

Figure FS-16: Fuels contractor audits completed over the last eight fiscal years.

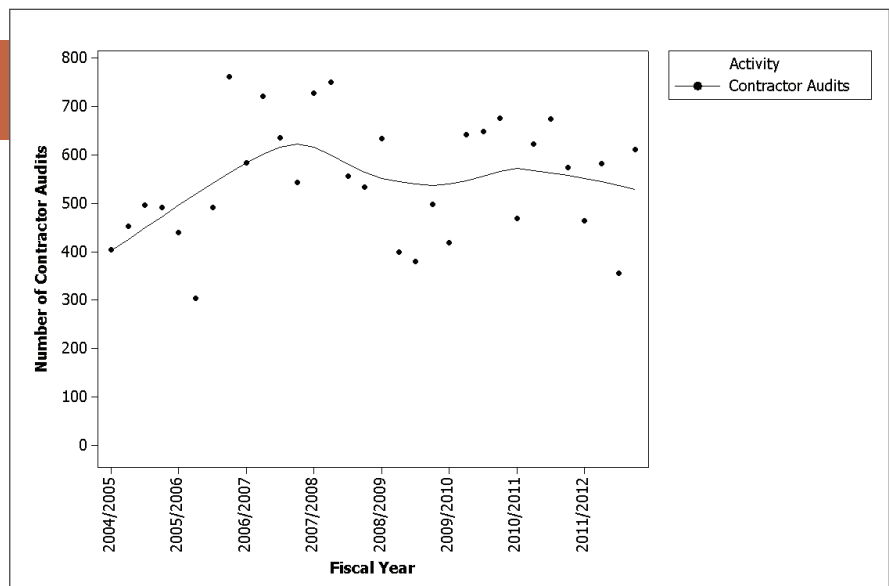


Figure FS-17 provides the average number of inspection orders per audit for the last eight fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per audit demonstrates an increasing trend over the period at a rate of 0.03 inspection orders per audit per quarter.

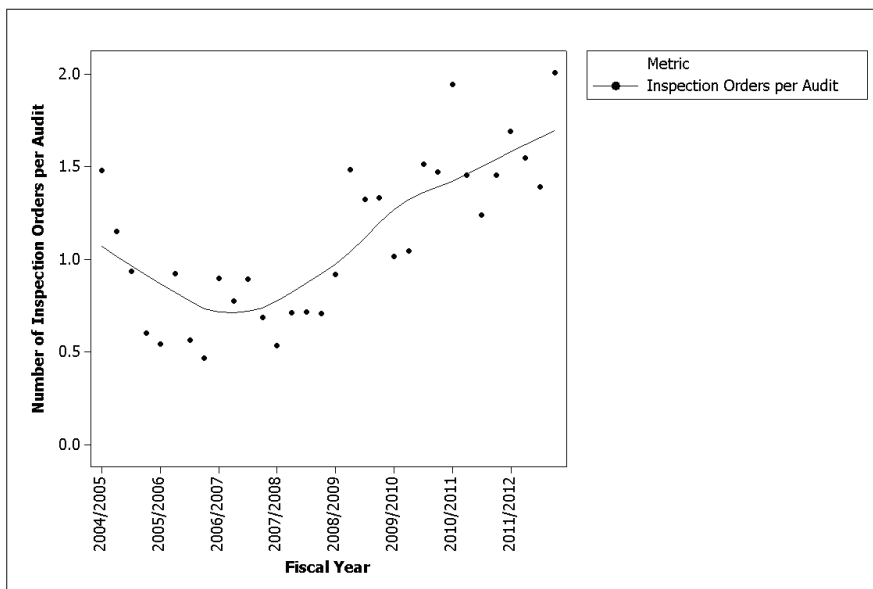


Figure FS-17: The number of inspection orders per fuels contractor audit over the last eight fiscal years.

Figure FS-18 charts the outcomes from fuels contractor audits completed over the last eight fiscal years. A statistical analysis of this data indicates that there is an increasing trend in the percentage of 'Cease & Desist' inspection outcomes over the period at a rate of 0.57% per quarter. This analysis also reveals that there is a decreasing trend in the percentage of 'Follow-up' inspection outcomes over the measured time at a rate of 0.79% per quarter. The 'Passed on first visit' inspection outcome did not demonstrate a significant trend.

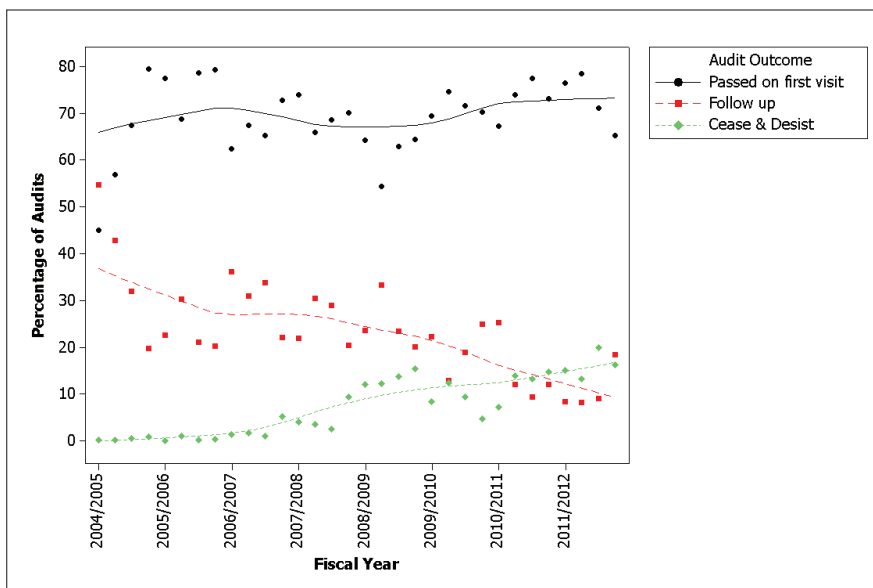


Figure FS-18: Fuels contractor audit outcomes by percentage over the last eight fiscal years.

Other Safety and Risk Analysis Results

The prediction intervals for the compliance outcomes for fuels, which represent the expected ranges of the indicator and are defined by the fifth and ninety-fifth percentiles of the trend data, are indicated in Table FS-7.

Table FS-7: Prediction intervals for compliance outcomes for fuels for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Periodic Inspections	Percentage Passed on First Visit	27.59%	64.20%
	Percentage Follow-up	35.07%	72.41%
	Percentage Cease & Desist	0.00%	1.93%
	Number of Orders per Inspection	1.15	2.98
Ad Hoc Inspections	Percentage Passed on First Visit	18.56%	42.52%
	Percentage Follow-up	16.82%	64.41%
	Percentage Cease & Desist	0.00%	47.57%
	Number of Orders per Inspection	1.43	2.62
Contractor Audits	Percentage Passed on First Visit	51.12%	79.32%
	Percentage Follow-up	8.35%	46.98%
	Percentage Cease & Desist	0.13%	17.51%
	Number of Orders per Inspection	0.51	1.97

The prediction intervals generated from the trend data for the safety outcomes for fuels are indicated in Table FS-8.

Table FS-8: Prediction intervals for safety outcomes for fuels for fiscal year 2012/2013.

Activity	Indicator	Lower Prediction Bound	Upper Prediction Bound
Occurrences	Number of Fatalities	0	10
	Number of Permanent Injuries	1	27
	Number of Non-permanent Injuries	0	16

Predicted Health Impacts

The health impact predictions for fuels safety were analyzed by occurrence types and lifecycle stages. The considered occurrence types were vapour releases, fires, explosions and carbon monoxide releases. The occurrence types that were omitted were discovery of petroleum products, leaks and spills. These omitted occurrence types do not typically result in a direct health impact; rather, they result in one or more occurrence types that in turn could lead to health impacts. Moreover, no health impacts have been observed in the past for these occurrence types. The life cycle stages of transmission, distribution and transportation, and storage and dispensing have been omitted for carbon monoxide releases. The release of carbon monoxide from pipelines or bulk plants are likely to occur in open spaces leading to negligible or no health impacts to the general public.

Figures FS-19 and FS-20 show the mean predicted DALYs per million people per year and mean fatality-equivalents per million people per year. The most significant observation is that the mean predicted health impact for carbon monoxide (CO) releases during the utilization stage is 143.2 DALYs per million people per year or about 3.2 fatality-equivalents per million people per year. The predicted fatality-equivalents is more than the risk acceptability criteria of one fatality per million people in a year. Most of these occurrences are found to be in private and multi-unit residential dwellings, followed by institutions with sensitive sub-populations which require further safety issue analysis and management. The figures indicate that the greatest contributor to health impacts is at the utilization stage across all the occurrence types.

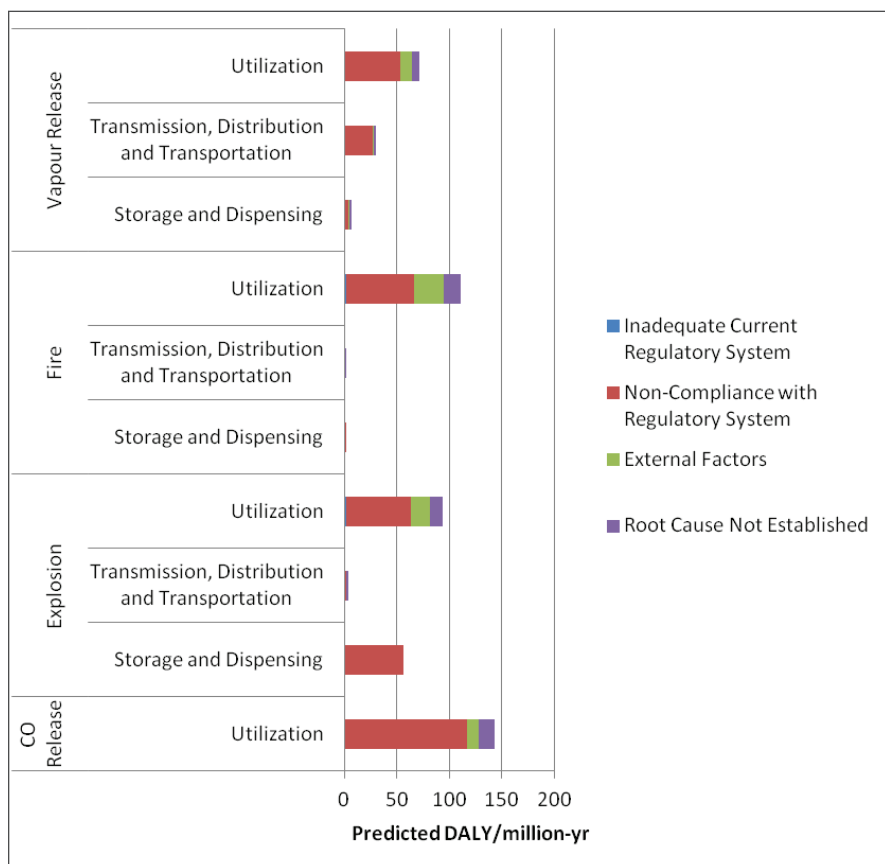


Figure FS-19: Predicted health impacts for fuels.

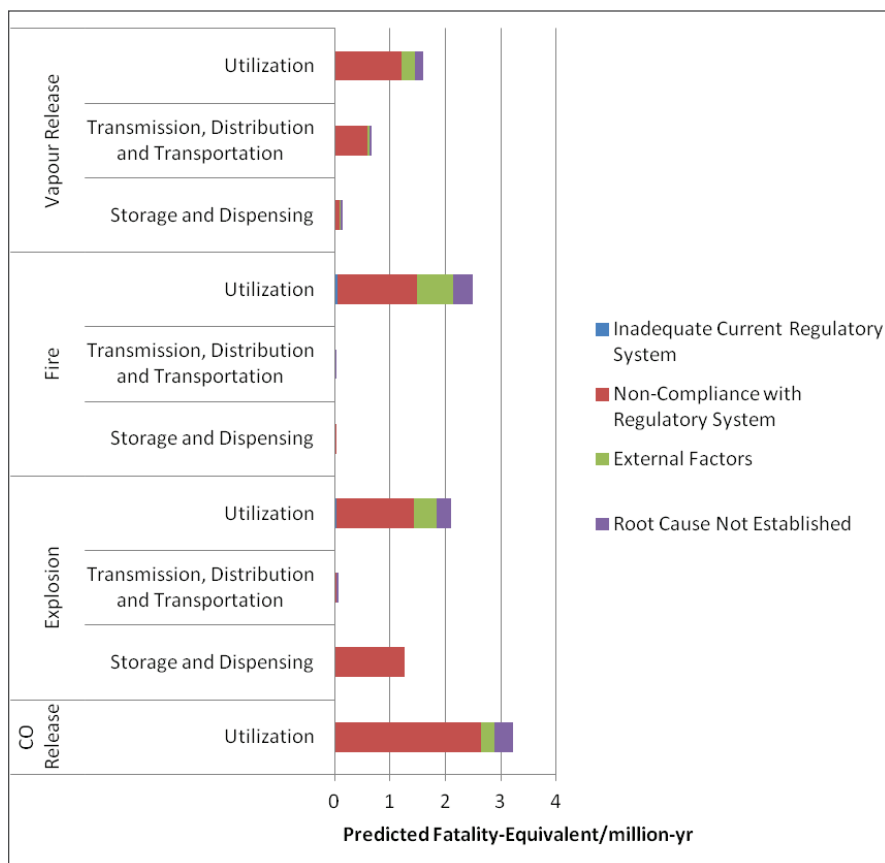
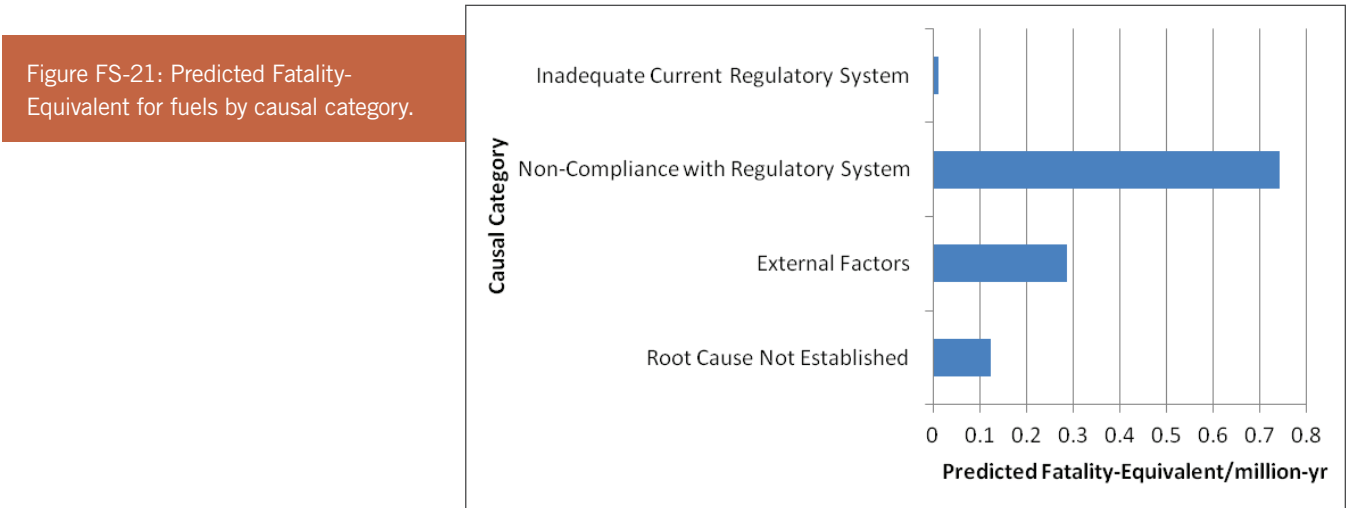


Figure FS-20: Predicted Fatality-Equivalent for fuels.

The mean aggregated prediction for fuel safety across all occurrence types and lifecycle stages is about 1.2 fatality-equivalents per million people per year and is beyond the risk acceptability criteria. Non-compliance with the regulatory system is found to be the major contributor towards the predicted health impacts as seen in Figure FS-21.



Risk Assessments

In response to a pattern of carbon monoxide incidents resulting from malfunctioning residential natural gas boilers with natural draft venting, TSSA conducted a comprehensive risk assessment study, which predicted that at least 5% of boilers functioning in the province are at unacceptable levels of risk. In response, TSSA issued a Director’s Order that effectively bans any future installation of such appliances unless they are isolated from living areas in homes. Additionally, for all existing appliances, additional maintenance and risk monitoring requirements have been mandated.

From October 15, 2009 to April 30 2012, there have been 64 occurrences associated with residential boilers with natural draft venting. There was one fatality and nine non-permanent injuries, accounting for 27.81 observed DALYs.

In this same time period, 24 inspection orders have been issued, of which 12 pertained to occurrences. Of the 12 orders that were not associated with an occurrence, six were issued during heating contractor audits, three were issued during ad hoc inspections, two pertained to enforcement actions during other inspections and audits, and one pertained to a complaint. The issuance of 12 inspection orders, resulting in averting potential health impacts of approximately 120 DALYs¹⁶, demonstrates a likely positive effect of TSSA’s actions.

Various failures have been observed with residential direct vent fireplaces that have or can have adverse impacts on property, public health and safety. Some of these observed/reported failures have resulted from a combination of different causal factors including, the design, manufacture, and installation of these appliances. A risk-informed strategy is being proposed to proactively address the observed safety issues with this equipment.

TSSA is currently conducting a risk assessment in order to identify hazards and estimate the risk associated with failure scenarios related to component and operability failures that could result in catastrophic consequences including health impacts.

A failure mode and effect analysis has been completed with the participation of TSSA experts and members of the Ontario Fire Marshal. Next steps include the completion of the risk assessment with the estimation and characterization of risk with the objective to make an informed decision.

¹⁶ A risk assessment study (TSSA, 2009) predicted a 22.3% chance of a fatality, for the observed carbon monoxide levels of 4000 ppm in boiler’s flue gas. If this high end value of 4000 ppm is used as a surrogate for the worst case and is assumed to occur if not detected through inspections, then approximately 10 DALYs (0.223 x 44DALYs) will have been averted per issued inspection order.

Upholstered and Stuffed Articles

The role of the Upholstered and Stuffed Articles Safety Program is to protect the public from potential hazards associated with the use of unclean or unsafe filling materials in upholstered and stuffed articles in Ontario. In addition to promoting safety, TSSA's aim is to protect consumers against fraud, misrepresentation of filling materials in upholstered and stuffed articles, and to provide a level playing field for the industry. Under *Ontario Regulation 218/01, Upholstered and Stuffed Articles*, the mandate of the program is to ensure that only new and clean filling materials are used in upholstered and stuffed articles, and that all articles are correctly labelled. Such articles include toys, sporting goods, pet items, furniture, mattresses, down-filled apparel, bedding items, handbags, luggage and seasonal ornaments. The requirements for new and clean filling materials are enforced through inspections at point-of-sale and the manufacturing level.

The introduction of the new information system in July 2009 was designed to allow for the collection of compliance outcomes enabling trend analysis. The information system also allows for a deeper level of analysis of inspection orders. On the basis of the information collected in this system, TSSA may apply its risk-informed decision-making framework and better inform inspection priorities.

The stages of the upholstered and stuff articles life cycle that fall under TSSA's jurisdiction are:

- supplier;
- manufacturer;
- importer/distributor;
- renovator; and
- retailer.

Analysis on State of Compliance

Inspection Analysis

The number of inspections completed in fiscal year 2011/2012 is presented in Table USA-1. The table also includes the total number of inspection orders issued in those inspections.

Table USA-1: Activity measures for upholstered and stuffed articles inspections for fiscal year 2011/2012.

Activity	Number of Inspections	Number of Follow-ups	Number of Inspection Orders	Number of Inspection Orders Per Inspection
Home Hobby/Craft Operator Ad hoc Inspection	5	1	4	0.80
Importer/Distributor Ad hoc Inspection	90	73	1579	17.54
Major Retailer Ad hoc Inspection	152	119	4779	31.44
Manufacturer Ad hoc Inspection	64	24	93	1.45
Printer Ad hoc Inspection	1	0	0	0.00
Renovator Ad hoc Inspection	53	31	33	0.62
Retailer Ad hoc Inspection	351	112	1147	3.27
Supplier Ad hoc Inspection	6	0	0	0.00
Trade Show Ad hoc Inspection	49	0	0	0.00
Complaint	6	0	6	1.00
Other Inspection	11	2	157	14.27
Home Hobby/Craft Operator Periodic Inspection	9	0	0	0.00
Importer/Distributor Periodic Inspection	60	36	767	12.78
Manufacturer Periodic Inspection	79	8	32	0.41
Renovator Periodic Inspection	59	7	14	0.24
Retailer Periodic Inspection	179	16	204	1.14
Supplier Periodic Inspection	2	0	1	0.50
Domestic Manufacturer Registration Inspection	1	0	0	0.00
Domestic Renovator Registration Inspection	0	0	0	0.00
Total	1177	429	8816	7.49

Table USA-2 breaks down the top infraction types by volume.

Table USA-2: Number of Inspection Orders by Infraction from inspections conducted for fiscal year 2011/2012.

Infraction Type	Number of Inspection Orders	Number of Inspection Orders Per Inspection
Manufacturer Not Registered in Ontario	2905	2.47
No Provincial Label	1988	1.69
No Contents Declared	881	0.75
Expired Registration	70	0.06
Non-approved Label Format	342	0.29
Incorrect Content Declaration	248	0.21
Country of Origin Conflicts with Registration Address	87	0.07
Unclean/unsafe Filling Material	17	0.01
Other	2,278	1.94
Total Number of Inspection Orders Issued	8816	7.49

Compliance Analysis

Inspections

There were 1,177 inspections conducted in fiscal year 2011/2012. Each of these inspections resulted in an outcome as determined by a TSSA inspector, shown in Figure USA-1. Of all inspections completed in fiscal year 2011/2012, 70.86% were compliant with regulations on the first visit. This includes instances where infractions were resolved upon conclusion of the inspection.

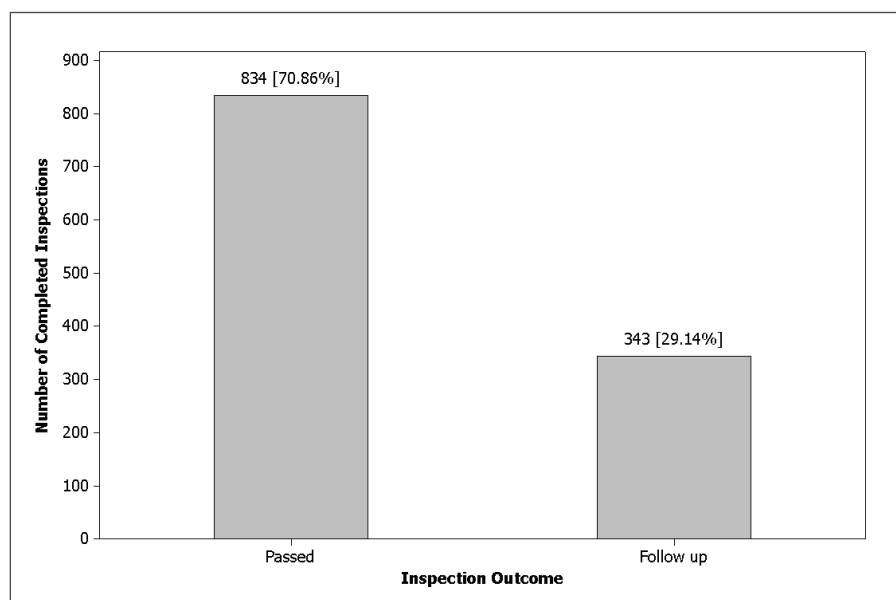


Figure USA-1: Outcomes from upholstered and stuffed articles inspections completed in fiscal year 2011/2012.

Compliance Related Trends

Figure USA-2 charts the number of non-follow-up inspections over the last three fiscal years. A statistical analysis of this data indicates that the number of non-follow-up inspections does not demonstrate a significant trend over the period.

Figure USA-2: Upholstered and stuffed articles non-follow-up inspections completed over the last three fiscal years.

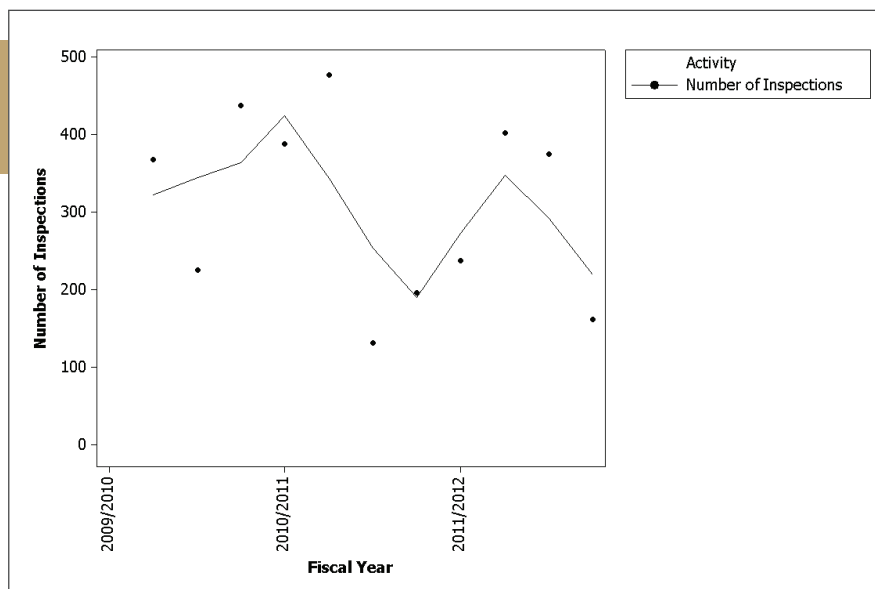


Figure USA-3 provides the average number of inspection orders per non-follow-up inspection for the last three fiscal years. A statistical analysis of this data indicates that the average number of inspection orders per non-follow-up inspection does not demonstrate a significant trend over the period.

Figure USA-3: The number of inspection orders per upholstered and stuffed articles inspection over the last three fiscal years.

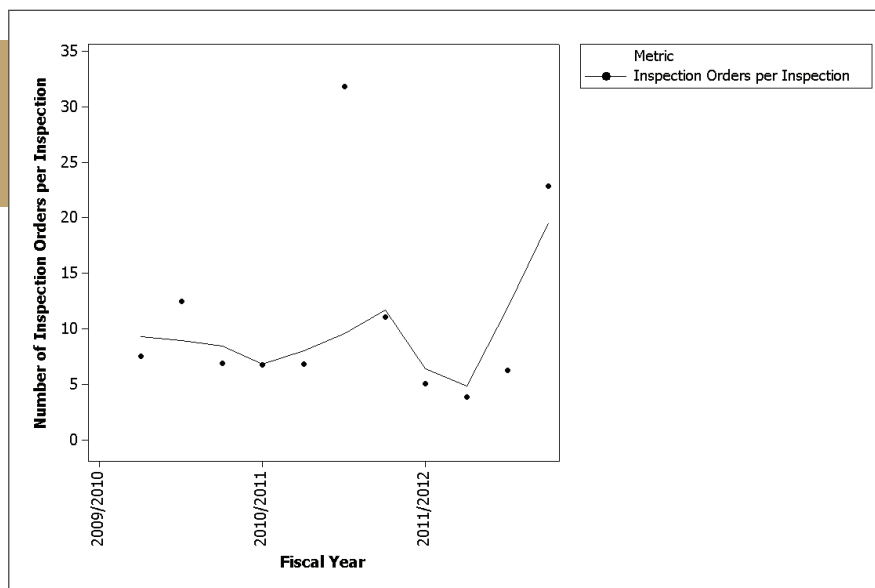


Figure USA-4 charts the outcomes from upholstered and stuffed articles non-follow-up inspections completed over the last three fiscal years. A statistical analysis of this data indicates that the inspection outcomes do not demonstrate any significant trends.

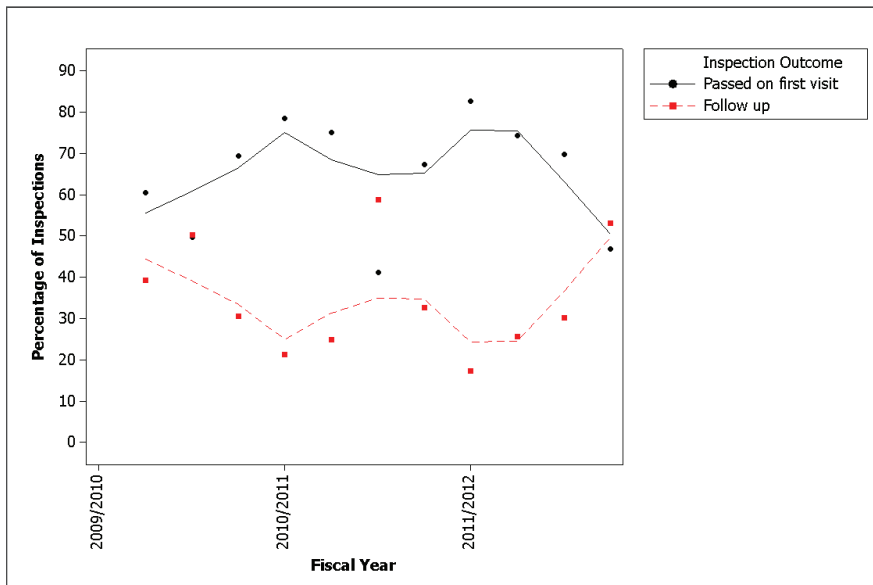


Figure USA-4: Upholstered and stuffed articles inspection outcomes by percentage over the last three fiscal years.

Life Cycle Analysis

Figure USA-5 charts the number of non-follow-up inspections by life cycle stage over the last three fiscal years. A statistical analysis of this data indicates that all the life cycle stages do not demonstrate any significant trends. The 'retailer' life cycle stage made up 63.07% of all non-follow-up inspections in fiscal year 2011/2012.

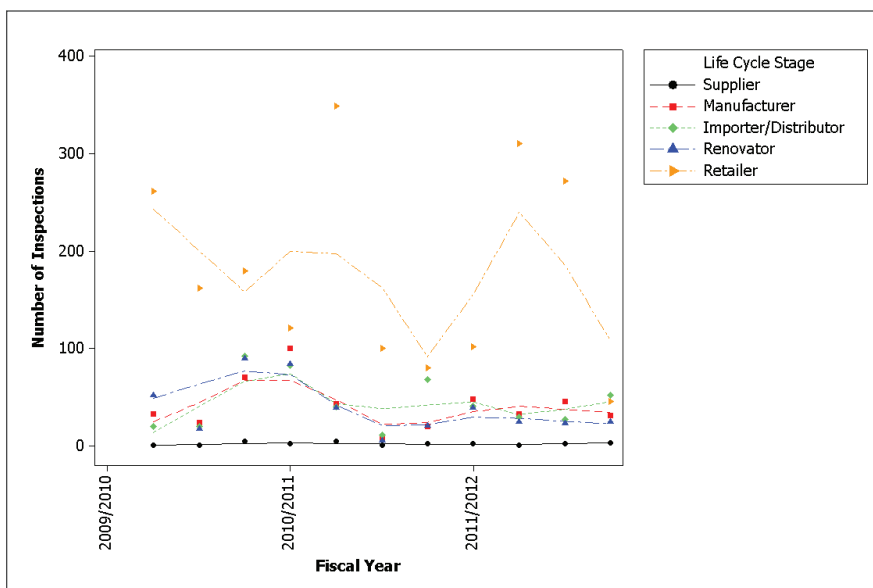
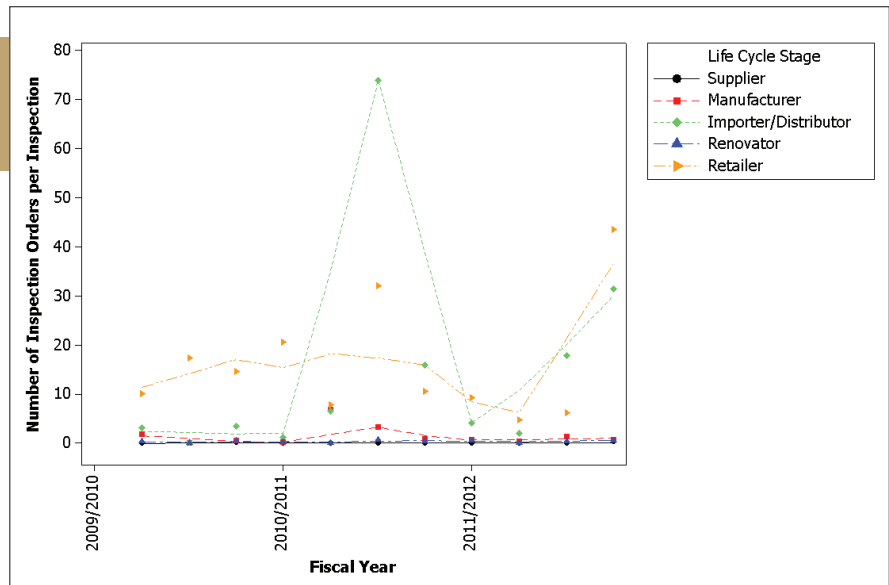


Figure USA-5: Upholstered and stuffed articles non-follow-up inspections by life cycle stage over the last three fiscal years.

Figure USA-6 provides the number of inspections orders per inspection by life cycle stage over the last three fiscal years. A statistical analysis of this data indicates that the 'importer/distributor' life cycle stage demonstrates an increasing trend over the period at a rate of 0.73 inspection orders per inspection per quarter. The number of inspection orders in the other life cycle stages does not demonstrate any significant trends.

Figure USA-6: Upholstered and stuffed articles inspection orders by life cycle stage over the last three fiscal years.



Article Type Analysis

The article types of the upholstered and stuff articles that fall under TSSA's jurisdiction are:

- bedding;
- clothing;
- stuffed accessories for electronic consumer products (e.g. cell phone cases, headphones);
- furniture;
- handbags/backpacks/luggage/accessories;
- medical equipment;
- pet items;
- seasonal items;
- sporting goods;
- toys; and
- other.

Figure USA-7 provides the number of inspection orders issued by article type in fiscal year 2011/2012. The three article types that were issued the most inspection orders were: furniture, clothing and medical items.

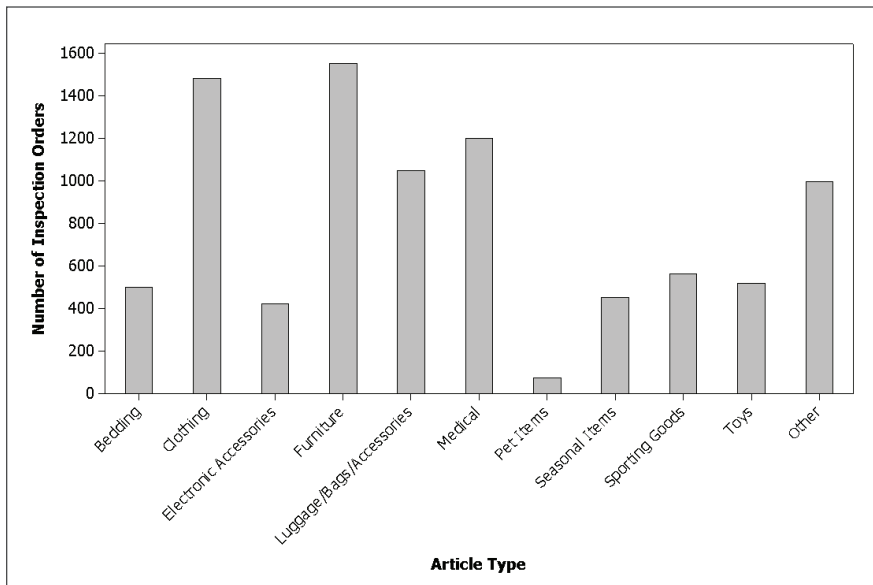


Figure USA-7: Upholstered and stuffed articles inspection orders by article type issued in fiscal year 2011/2012.

Figure USA-8 provides the number of inspections orders issued by article type over the last three fiscal years. A statistical analysis of this data indicates all of the article type categories do not demonstrate significant trends.

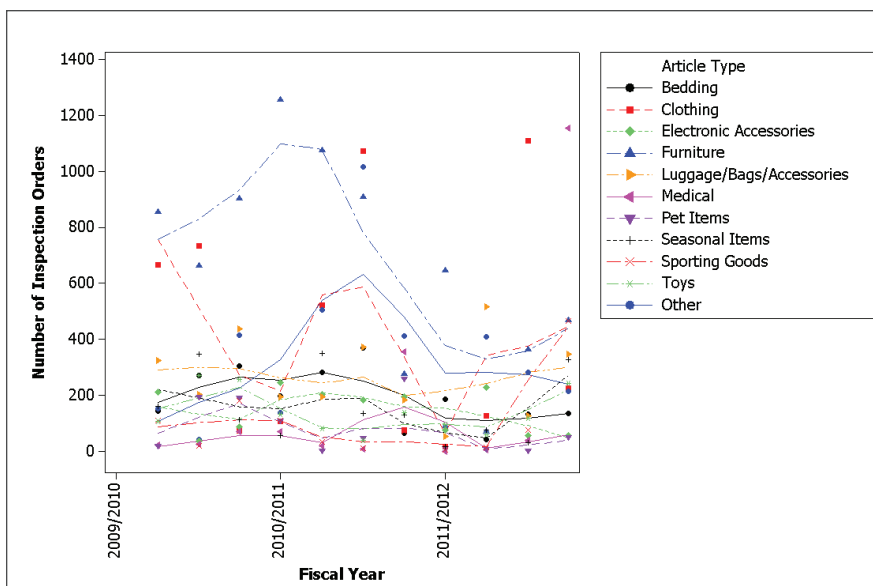


Figure USA-8: Upholstered and stuffed articles inspection orders by article type issued over the last three fiscal years.

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Appendix A - Statistical Methods

The statistical analysis of time series of data in this report includes:

- graphical data analysis;
- construction of prediction intervals;
- trend tests; and
- slope estimates.

Time series plots are used to present the data graphically. These plots provide insight into the data for the analysts and readership. Time series plots are two-dimensional scatter plots and illustrate the relationship between a random response variable of interest and time. The human eye is an excellent judge of the range of data on a scatter plot, but has a difficult time accurately judging the pattern of how a variable varies over time. Scatter plots have the limitation that the presentation of a large number of data points can become rather clustered and unintelligible.

To aid in the trending judgment, a smooth local curve is superimposed on the data in the report. There are various smoothing methods that fit a centre line to the data; the direction and slope of this line varies locally in response to the data itself. The analysis in this report uses a method known as Locally Weighted Scatter plot Smoothing (LOWESS) to fit lines to the data. This method is more robust to outliers than the method of ordinary least squares regression, and does not require residuals to satisfy the assumptions of normality and constant variance. Additionally, unlike the regression method, the shape of a smooth is not specified *a priori*, but rather is determined solely by the data. Adding a smooth line through the middle of the data aids judgment of whether the pattern is linear and indicates where breaks in slope occur. To aid in the graphical data analysis, the smoothers are superimposed on the data using Minitab 16®.

A prediction interval is an estimate of an interval into which a new observation will fall, with a certain probability, given what has already been observed. In this report, the prediction interval covers between the 5 and 95 percentiles of the measured data. Observations for those indicators lying outside the prediction intervals are made with a 95% confidence level. Prediction intervals allow indicators to be checked on a quarterly basis, verifying if they fit the behaviour of historical observations.

Trend tests allow for statistical hypotheses testing. This has two advantages over graphical data analysis:

- it ensures that every analyst of a data set using the same methods will arrive at the same result; and
- it presents a measure of the strength of the evidence (the p-value).

The current study uses the Mann-Kendall test in the determination of whether the probability distribution from which response values arise has changed over time. The Mann-Kendall test is a non-parametric test, and does not require any assumption of normality or canonical distributions in the data. This test is robust to outliers and allows missing data to be present in the analysis. To better discern the trend in the response variable, efforts have been made to remove the effects of other exogenous variables in this report (such as the number of inspections conducted).

There are many instances where seasonality is the source of variation in the response variable. This report uses Kruskal-Wallis statistics for testing seasonality in the time series. These statistical tests on the data are done using the Minitab 16® software. If evidence is found for seasonality, then the Seasonal Mann-Kendall trend test is used instead of the Mann-Kendall test.

The assertions of any of these tests are made with 95% confidence.

An estimate of the slope is constructed using Sen's method. This method calculates the slope for each pair of points in the data, and utilizes the median of these calculated slopes as the estimate. When the data is seasonal, only points from the same season are used in the pair-wise slope calculation. This slope gives an estimate of the rate of change of the data, assuming that it responds linearly with time.

Appendix B - Causal Analysis Categories

There are three causal analysis categories into which occurrences with a root cause can be categorized. The description of each category and the associated mapping of root cause information are listed below. Occurrences that do not have an established root cause after inspection are contained in a fourth category, root cause not established.

Inadequate Current Regulatory System

Occurrences in this causal category indicate potential areas in need of regulatory change or improvement. They are consistent with the regulatory gap and impact analysis currently used by Ministry of Consumer Services to effectively improve the regulatory system without imposing unnecessary additional regulatory burden.

Table B-1: Causes contained in the Inadequate Current Regulatory System category.

Category	Definition	Sub-Categories
Design	Factors related to the engineering outline and physical make-up of a device for its intended purpose.	▪ Defective or inadequate design. ▪ Defective/inadequate safety features, or devices.
Management	Factors related to the levels of responsibility that are accountable for specific activities, programs and systems of operation.	▪ Gaps in the regulatory management system.

Non-compliance with Regulatory System

Occurrences in this causal category most appropriately reflect TSSA's effectiveness in administering the safety system and obtaining compliance. They allow TSSA to allocate enforcement resources to areas of greatest risk.

Table B-2: Causes contained in the Non-compliance with Regulatory System category.

Category	Definition	Sub-Categories
Design	Factors related to the engineering outline and physical make-up of a device for its intended purpose.	▪ Inappropriate equipment or material selection. ▪ Inappropriate drawing, specification or data.
Equipment/Material/Component	Factors related to a device (machinery), the physical constituents of a device (material used or make-up) or a specific unit of an overall device of machinery.	▪ Defective, failed, or malfunctioning equipment. ▪ Defective or failed component including safety devices. ▪ Defective or failed material. ▪ Defective assembly. ▪ Electrical or instrument noise or malfunction. ▪ Contamination of material, component or equipment.
Human Factors	Factors related to actions or inactions of humans in the execution of activities in the operation of equipment or in the general work environment.	▪ Inadequate or unsafe operating environment. ▪ Failure to follow maintenance procedures. ▪ Failure to follow operating procedures. ▪ Failure to follow installation procedures. ▪ Inappropriate plant operator attendance. ▪ Incomplete or inadequate internal communication. ▪ Incomplete or inadequate external communication.
Maintenance Procedures	Factors related to repair and upkeep activities required for the preservation of a device during its useful life cycle.	▪ Defective or inadequate maintenance procedures. ▪ Lack of maintenance procedures.
Management	Factors related to the levels of responsibility that are accountable for specific activities, programs and systems of operation.	▪ Inadequate or defective management systems. ▪ Lack of management systems. ▪ Improper or negligent work practices.
Procedures	Factors related to guidelines that outline how specific activities should be executed.	▪ Defective or inadequate operating procedures. ▪ Lack of operating procedures. ▪ Lack of or inadequate safety procedures. ▪ Defective or inadequate installation procedures. ▪ Lack of installation procedures.
Training	Factors related to documented programs that prepare employees for the proper execution of specific work activities as required.	▪ Lack of training programs. ▪ Defective or inadequate training programs.

External Factors

Occurrences in this causal category indicate occurrences that are outside the control or influence of TSSA. This category prevents inappropriately misrepresenting occurrence cause to TSSA's performance with respect to compliance or the effectiveness of provincial regulations, and allows for the identification of other mitigation measures.

Table B-3: Causes contained in the External Factors category.

Category	Definition	Sub-Categories
External Factors	Factors representing occurrences beyond human control or TSSA regulatory control.	▪ Weather or other environment conditions. ▪ Utilities disruption or failure. ▪ External incidents. ▪ Sabotage, terrorism, vandalism or theft. ▪ Non-compliance with non-TSSA regulations.
Human Factors	Factors related to actions or inactions of humans in the execution of activities in the operation of equipment or in the general work environment.	▪ Special conditions. ▪ Failure to follow user instructions. ▪ Deliberate intent or sabotage.

Appendix C - Disability-Adjusted Life Year (DALY) Metric

A DALY of 1.0 is the loss of one year of healthy life of a single person due to an injury. For comparison purposes, DALYs are expressed per million of population. For example, a DALY of 28.1 per million for a fiscal year means that 28.1 years of useful life were lost per one million people in Ontario for that year due to injuries arising from all the sectors TSSA regulates.

The disability-adjusted life year is a universal health impact metric introduced by the World Health Organization as a single measure to quantify the burden of diseases and injuries. The DALY can be thought of as equivalent years of “healthy” life lost by virtue of being in states of poor health or disability and/or due to premature fatality. The number of DALYs for a fatality is calculated based on the standard life expectancy at age of death in years and is based on age and sex (e.g., fatality of a male child aged 5 would translate to 70 DALYs as the average life expectancy is 75 years). The number of DALYs for an injury is calculated by multiplying the average duration of the injury by a weight factor that reflects the severity of the injury on a scale from 0 (being in perfect health) to 1 (being dead).

Health loss is characterized by three dominant aspects of public health:

- quality of life;
- quantity of life; and
- social magnitude.

The quality of life is measured by duration of injury and life expectancy of a victim. The quantity of life lost is expressed through disability weights, and the social magnitude is characterized by the number of people affected. As discussed earlier, DALYs can be expressed per million of population.

The DALY can be calculated by the following equation: $DALY = (Short\text{-}term\ Weight * Short\text{-}term\ Duration) + (Fraction\ Long\text{-}term) * (Long\text{-}term\ Weight * Long\text{-}term\ Duration)$.

There are four injury types categorized in the TSSA database: i) fatality, ii) permanent injury, iii) non-permanent injury, and iv) no injury. The permanent and non-permanent injuries are further characterized by 28 specific types of injury descriptions. In the above equation, disability weights, fraction long-term, and short-term durations, associated with the various injury descriptions, have been adopted and/or modified from the Australian Burden of Disease and Injury Study¹⁷. The long-term durations were adopted from the global burden of disease study by age and gender using the following age groups (cohorts): 0–4, 5–14, 15–24, 25–34, 35–44, 45–54, 55–64, 65–74, 75 and older.

¹⁷ Begg S, Vos T, Barker B, Stevenson C, Stanley L and Lopez A: The burden of disease and injury in Australia 2003. Cat. No. PHE 82. Canberra: AIHW 2007.

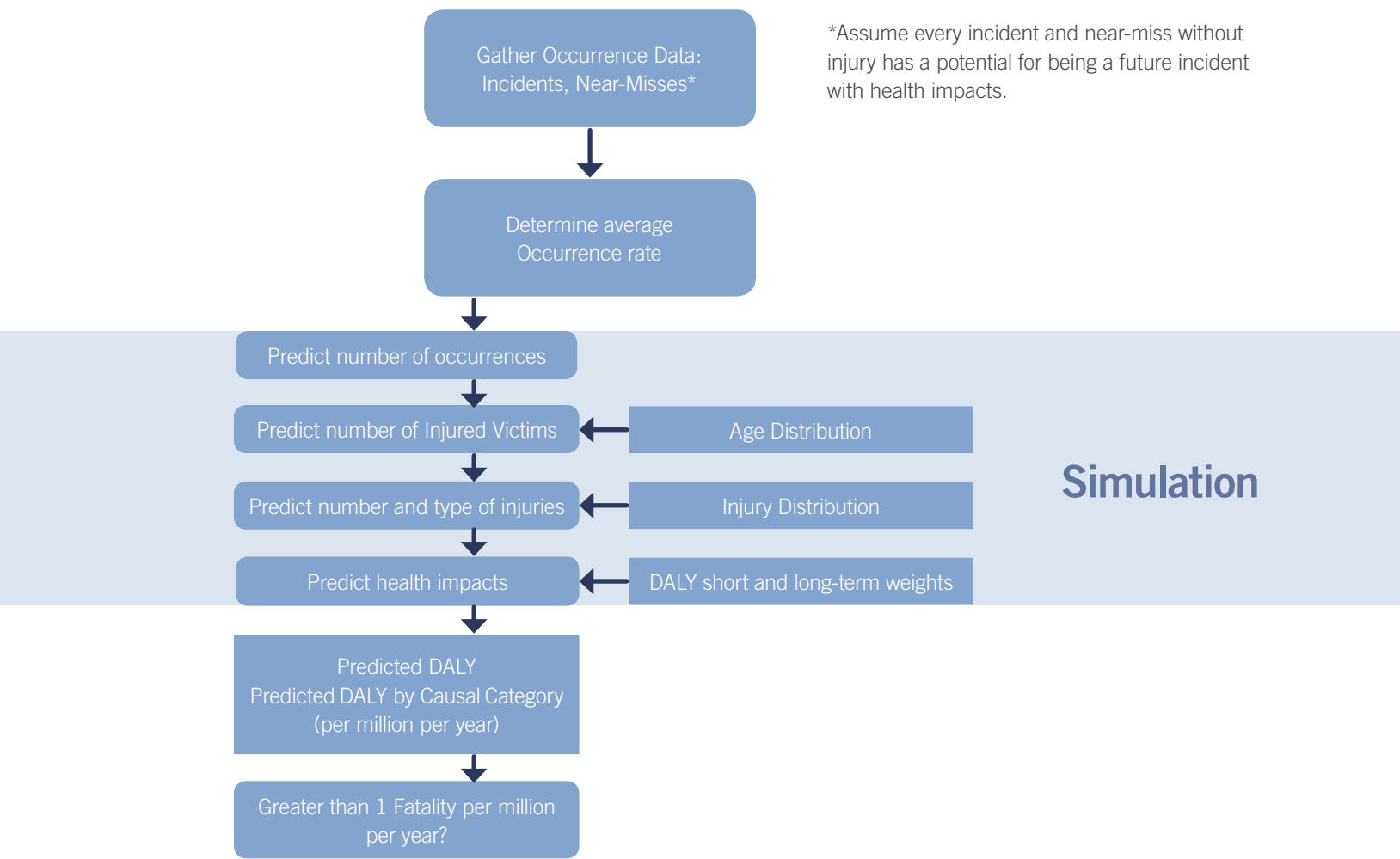
A hypothetical example is presented to better understand the DALYs calculations. Assume a male victim sustains a spinal injury at the age of 30 years due to the malfunctioning of a regulated technology. The equivalent healthy years lost due to the spinal injury can be calculated as 34.87 by using the above equation. In this calculation, the short-term weight of 0.725 and duration of 0 years are used respectively. For fraction long-term and long-term duration parameters, the values of 1 and 0.725 were used, respectively, in calculating the injury burden. The cohort life expectancy of 48.1 years, for the age group of 25 to 34 years, is used in the above calculation.

One further advantage of the DALY metric for safety performance reporting is that it allows the root cause of incidents to be established and divided into the three categories listed in Appendix B.

Predicted DALY Metric

TSSA has been quantifying and reporting health impacts based on actual observations using the DALY metric since FY 2010/2011. The predicted DALY approach on the other hand accounts for historic occurrences irrespective of the health consequences and predicts the future state of safety in terms of Predicted DALYs per million Ontarians per year. The rationale behind this approach is that there is a potential for some of the occurrences without health impacts to manifest themselves as incidents with injuries and fatalities in the future. The predicted DALY is then converted to a fatality-equivalent to enable comparison with the international risk acceptability criteria¹⁸ of 1 fatality per million people per year. The prediction assumes that the number of occurrences per year, number of victims per occurrence, age of each victim and the number and type of injuries per victim in the event of an occurrence are random. A simulation approach is used to conduct the predictions since there is uncertainty in the expected number of future occurrences and variability in the age of Ontarians. The procedure followed to determine the anticipated health impacts is shown in the flowchart below.

Figure: Flowchart to predict future health impacts.



The end result is a frequency distribution of health impacts categorized by causal factors. The 50th percentile representing the mean value of this distribution is used for reporting purposes in this report.

¹⁸ University of British Columbia (2011), Risk Acceptability Criteria for effective regulation of technological risks, technical report submitted by Faculty of Applied Science, School of Engineering for Technical Standards and Safety Authority (TSSA).

Appendix D - Glossary of Terms

Cease and Desist	Applies to an activity or a person and is an order to cease an activity that is in non-compliance or could create an unsafe condition.
Complete	An inspection that has been executed with no outstanding non-compliances (hazards) found.
Director's Order	A regulatory decision made by a Statutory Director under the powers given to him/her as per Section 31 of the <i>Technical Standards and Safety Act, 2000</i> .
Disability-Adjusted Life Year (DALY)	A DALY of 1.0 is the loss of one year of healthy life of a single person due to an injury. Please see appendix C for a full description. Predicted DALY Predicted DALY is a unit of measure to predict the number of healthy life years lost in a future year in terms of the DALY metric for the exposed population of Ontario. The predictions are based on historic occurrences and reflect the future state of safety. Observed DALY Observed DALY is a safety metric that quantifies healthy years of life lost due to injuries and fatalities resulting from an occurrence reported to TSSA. Health impacts due to occurrences established to be outside TSSA's jurisdiction are not accounted for in the observed DALY.
Fatality-Equivalent	The fatality-equivalent is a unit of measure obtained by converting healthy life years lost due to injuries and fatalities into an equivalent count of fatalities observed in a million people in a year. The conversion is aided through the application of the DALY metric. The fatality-equivalent measure facilitates benchmarking against internationally recognised risk acceptability criteria of 1 fatality per million people in a year.
Follow-up	An inspection with this outcome has revealed non-compliances that must be corrected and verified by an inspector.
Incident Management Information System (IMIS)	A public safety decision-support information tool that enables TSSA to document the receipt, dispatch, investigation and analysis of reported occurrences and forms a component of the Incident Management System (IMS).
Incident Management System	A structured framework that translates the legislated regulatory responsibilities of TSSA, specifically as it pertains to incident investigations into a management system. This management system contains policies, procedures, roles and responsibilities and associated processes that enable the receipt, investigation and analysis of reported occurrences.
Incident Occurrence	An occurrence involving a system/device/component under TSSA's jurisdiction, whereby a hazard is exposed resulting in a consequence to people or property.
Inspection	An official examination of a device, system or procedure aimed at forming a safety assessment of the device, system or procedure.
Inspection Order	Referenced in Section 21 of the <i>Technical Standards and Safety Act, 2000</i> , an inspection order is the direction issued by an inspector to address any contravention to the provision of the Act, the regulations including codes, or a Minister's order. An inspection order is sometimes referred to as an enforcement action.
Non-permanent Injury	The consequence of an incident occurrence wherein there was an observed health impact that was estimated to be non-permanent based on the nature of the injury and its associated severity using a methodology developed by the World Health Organization (WHO). A non-permanent injury has no significant impact on the individual's life expectancy at the time of injury.

Near-Miss Occurrence	An occurrence involving a system/device/component under TSSA's jurisdiction, whereby a hazard is exposed demonstrating an instance of elevated exposure to risk, while in this particular instance resulting in no consequence to people or property.
Occurrence	The realisation of a hazard which results in, or has the potential to result in, a consequence to people or property.
Occurrence Inspection	A detailed inquiry into an occurrence, including the gathering of information, which is undertaken officially to ascertain the cause(s) and consequence(s) of the occurrence.
Outcome	The output or the end result of an activity or event. The documented end result of actions or the execution of a process.
Passed on First Visit	An inspection that has been executed with no outstanding non-compliances (hazards) found after the inspection is complete.
Periodic Inspection	An inspection conducted at such intervals as may be determined by the Statutory Director or required by code or regulation for the purpose of ensuring the safe operation of the device/facility.
Permanent Injury	An injury sustained by an individual that partially or permanently impairs the normal abilities of that individual for the rest of his/her expected remaining life.
Prediction Interval	A prediction interval is an estimate of an interval into which a new observation will fall, with a certain probability, given what has already been observed. In this report, the prediction interval covers between the 5 and 95 percentiles of the measured data. Observations for those indicators lying outside the prediction intervals are made with a 95% confidence level.
Reporting Bias	Reporting bias reflects the belief that the source lacks awareness to report or lacks clarity on what to report or is unwilling to report accurate or full information about an incident or a near-miss. The source could be a victim, witness, home owner, property manager, contractor or member of the general public.
Root Cause	The most basic reason (underlying cause) for an occurrence that can be reasonably identified.
Shutdown	Inspections that identify non-compliances that must be rectified and verified by an inspector before the device can be operated.
Voluntary Shutdown	Non-compliances were found which would have warranted a failed inspection, a shutdown or conditional pass but the owner has voluntarily decided to shut the device down.



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