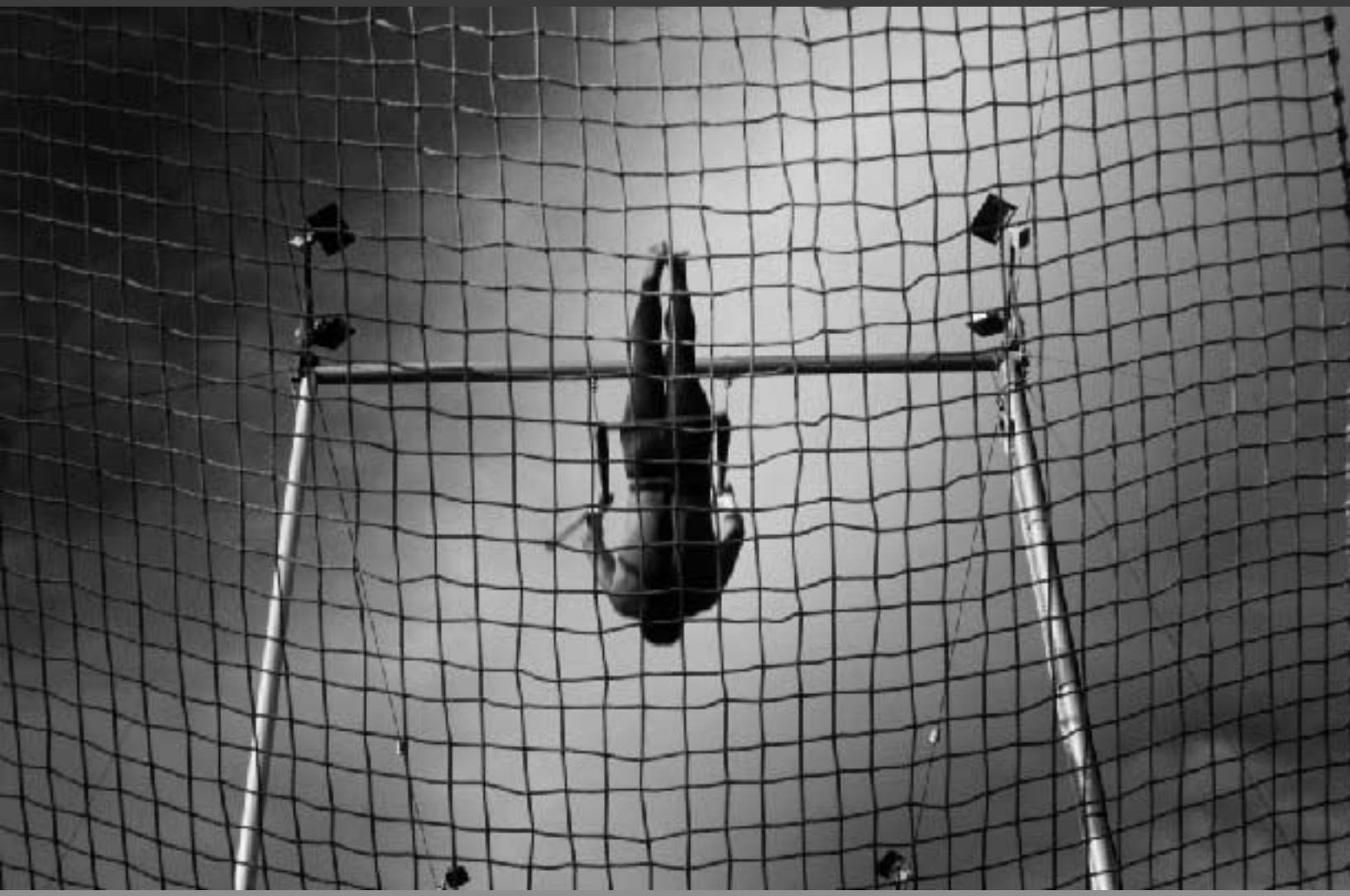
2004 – Ontario Electrical Safety Report

Defining the Safety Net



Electrical Safety Authority

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Executive Summary

The fatality rate of an electrical nature continues to decline in Ontario. The electrocution rate in 1971 was 3.8 deaths/million population compared to 0.64 deaths in 2004, a decrease of 83%. In the last seven years, Ontario is averaging 11.4 deaths per annum.

There were a total of 80 electrocutions between 1998-2004; fifty-two were occupational. The ratio of occupational electrocution to non-occupational electrocution in this period is approximately 2 to 1. Of the eight electrocutions in 2004, there was only one non-occupational related electrocution. Thus, the trend of having more occupational electrocutions than non-occupational electrocution continues. The trend of having no females in electrocution cases also continues. In 2004, no females were electrocuted.

2004 was quite uncharacteristic in its number of fatalities involving powerline contact. In previous years, there were usually an equal number of powerline and non-powerline deaths. 2004 had only two powerline related deaths.

Predominance of residential electrocution continues, accounting for 32% of all electrocutions in Ontario. Fatalities in industrial and public places represented another 18% of fatalities each.

Seventy-six percent of electrical fatalities occurred outdoors in the 1998-2004 period. Fifty-eight percent involved powerline contact. Powerline contact represents 75% of all outdoors fatalities. Ladders, as in previous year, represented 75% of occupational deaths in residential facilities involving powerline.

According to the Ministry of Labour, from the 7 occupational fatalities in 2004, workers in five fatalities were aware they were working near an energized system

when they were electrocuted. The other two incidents were the result of inadvertently contacting energized lines.

Despite no ladder fatalities in 2004, ladder fatalities still accounts for 35% of all electrocutions in the residential facilities between 1998 and 2004. Three-quarters of ESA investigated incidents involving utility-owned equipment were fatalities in nature.

Since 2000, there is at least one fatality each year involving a farmer each year. These occurrences were mostly in the western part of Ontario, where farming community is most prominent.

The MOL statistics indicated a decline in occupational critical injuries of an electrical nature. 1n 1998 there were 34 critical injuries reported to the MOL compared to 21 in 2004, a drop of 38%.

Fire fatalities, where electricity was identified as the ignition source has been declining since 1998. Most were caused by misuse of the equipment or device, such as cooking equipment left unattended. The number of electrical fires that resulted in deaths but not caused by misuse of electrical equipment represents 13% of electrical fire deaths. Cooking continues to be the most common cause of electrical fire-related fatalities.

Electrical fires resulting in injuries have been declining since 1995. In 1995, there were 350 injuries as the result of electrical fires compared to 160 in 2003, a drop of 54%. However, when compared to the number of fires in the corresponding period, the prevalence of fire that resulted in injuries has not changed at all. For every 100 electrical fires, we can expect 6 injuries.

Multimeter use and working live on 347-volt system continue to cause serious injuries in Ontario. In the past seven years, 347 Volt and Multimeter related

incidents have accounted for a combination of approximately 6 fatalities and critical injuries annually. Without intervention, this pattern will likely continue in the future. ESA is implementing an action plan in 2005/2006 to address this issue.

Please note that some of the efforts required to reduce electrical fatalities, injuries and property damage were beyond ESA's scope, mandate and responsibilities.

ESA is continuing with safety initiatives involving general safety awareness, 347-volt system, multimeters, outlets, powerline and safe ladder use to reduce future electrical death, injuries and damage.

1.0. Introduction

This is the fourth annual report of the state of electrical safety in the Province of Ontario. The report is produced by the Electrical Safety Authority, titled "Electrical Safety in Ontario 2004 Report".

ESA operates under the Electricity Act, 1998, which designates ESA as the authority responsible for the enforcement of the electrical safety requirements (section 113) of the Electricity Act. The Act empowers ESA, subject to government approval, to make or amend the Ontario Electrical Safety Code and to make change to regulations. To ensure compliance with the OESC, ESA is given the authority to inspect all electrical work and installations in Ontario. ESA was also given the authority in May 2004, to establish the minimum electrical safety requirements for the design and construction of electrical distribution systems. In November 2004, ESA was further granted the authority to license electrical contractor with targeted implementation of January 2007.

The report was made possible with the assistance from safety partners; namely the Ministry of Labour (MOL), Workers' Safety Insurance Board (WSIB) and the National Work Injury Statistics Program (NWIS) for occupational fatalities, injuries and incidents, the Office of the Fire Marshal (OFM) for fire-related electrical accidents and incidents, the Chief Coroner for Ontario for cases of fatalities in Ontario. Unlike previous years, ESA was not able to obtain information in time from the Canadian Institute of Health Information (CIHI) for non-occupational injuries across Canada due to administrative difficulties. For that reason, non-occupational injuries are not included in this report.

With the Electricity Distribution Safety Regulations in place, all utility related incidents have been separated in this report to provide focus to this particular section of the industry.

2.0. Electrocutions

This section is largely based on the compilation of the Ontario Coroner's records from 1998 to 2003 and ESA records from 1999-2004[1].

Electrocution cases in this report are all incidental electrical contacts. Suicides, deliberate actions to injure are excluded but electrocutions as a result of a vehicle driving into a utility pole, act of vandalisms, pranks and theft of electricity are part of this report. In this report, fatalities as a result of electrical fires are shown in the electrical fire section of the report.

This section of the report analyzes workplace related fatalities and non-occupational fatalities caused by incidental electrical contact.

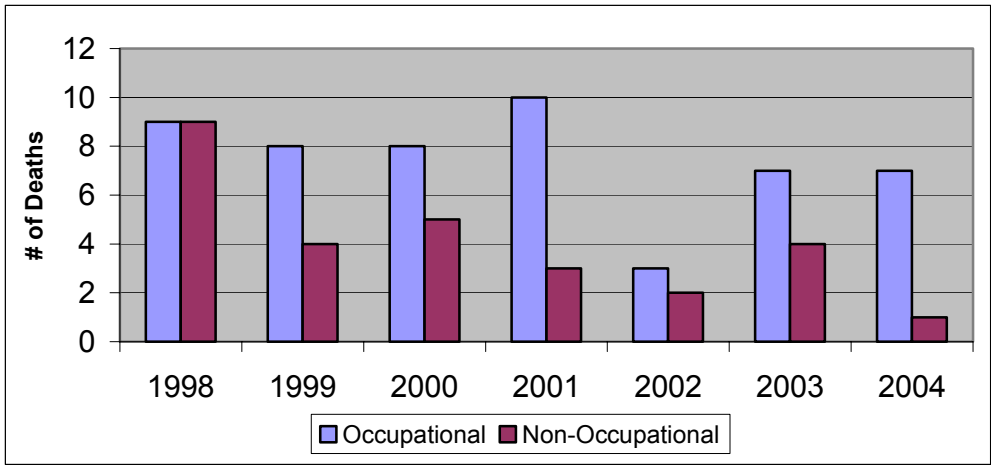
Ontario experienced 80 electrocutions between 1998 and 2004. Incidental electrical deaths in that period have been averaging 11.4 deaths per annum (Figure 1). The electrocution rate for the Province[2], has decreased from 3.8 deaths per million populations in 1971, to 0.64 in 2004, a decrease of 83%.

A review of the Coroner's reports in 2005 provided information on the two unknown fatalities in ESA 2003 Safety Report. The number of fatalities in 2002 has also been revised to reflect the Coroner's records. Please also note that one of the fatalities in 2003 was coded as "Fire – thermal injury death" by the coroner[3], thus, there is a difference in total count of electrical fatalities from ESA and the Coroner's office.

Electrocution rate for the Province, has decreased from 3.8 deaths per million population in 1971, to 0.64 in 2004, a decrease of 83%

[1] ESA's records for 2003 and 2004 are preliminary and may change with confirmation from the coroner's office.
[2] Electrocution rate is calculated as number of fatalities per million population.
[3] E-mail dated May16, 2005, Lindsell to Hardy

Figure 1
Electrocution in Ontario[4]
1998-2004



A quick snapshot of electrocutions between 1998 and 2004 (80 fatalities) reads as follows;

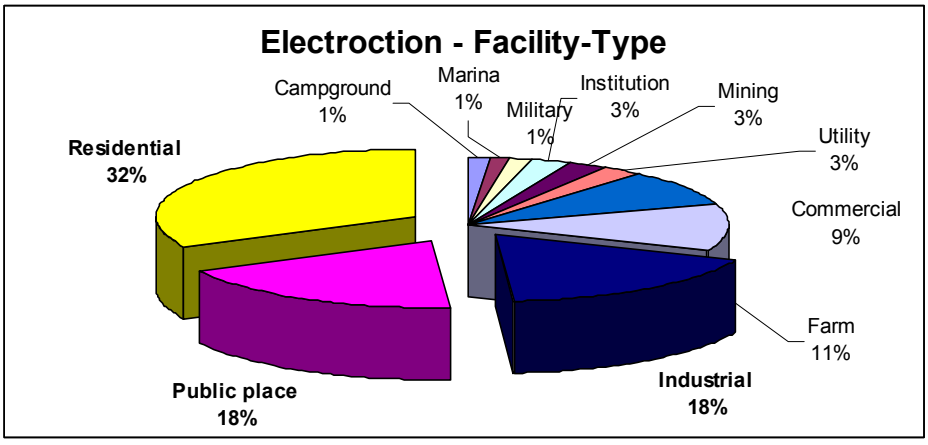
- Males accounted for 94% of reported electrocutions (75 deaths).
- No females were electrocuted in 2004. Thus, the number of females electrocuted remains at 5 as per ESA 2003 Safety Report and the prevalence of male electrocution keeps increasing.
- There were 52 occupational electrocutions in the seven-year period and 28 non-occupational electrocutions. The ratio of occupational to non-occupational deaths is almost 2 to 1, compared to 1.64 to 1 in the preceding seven years. The change in ratio is the direct result of having 7 occupational fatalities in 2004, compared to 1 non-occupational fatality.
- High Voltage[5] contact resulted in 47[6] electrocutions or 59% of all incidental fatalities by electricity.
- 2004 was quite uncharacteristic with its lower number of powerline deaths. In previous years, powerline fatalities usually accounted for at least 50% of fatalities. In 2004, there were only two powerline fatalities.

[4] Based on ESA records
[5] Voltage over 750 Volts, usually related directly to overhead powerline.
[6] Some fatality records were re-classified after receiving more information from the Coroner's office.

- Despite the low number of powerline electrocutions, Ontario still saw 8 electrocutions in 2004.
- There were 61 outdoor fatalities and 19 indoor fatalities for the seven-year period. Outdoor fatalities accounted for 76% of all fatalities.
- Residential facilities accounted for 32% of electrocutions (see Figure 2). Public places and industrial facilities are next prevalent at 18% each. These three facility types accounted for 68% of electrocutions when sorted by facilities.
- There were 18 electrocutions in the residential facilities that resulted from powerline contact. Half of the powerline contacts in the residential facilities involved conductive ladders.
- There have been a total of 6 deaths involving farmers and powerlines in 1998-2004 period. They have all occurred in western Ontario.

The ratio of occupational to non-occupational deaths is almost 2 to 1.

Figure 2
Electrocution – Facility Involved[7]
1998-2003

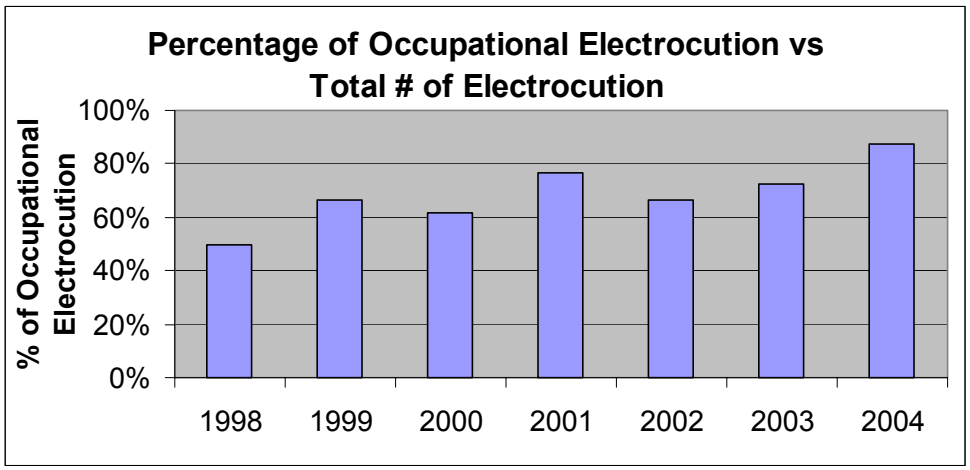


[7] Based on ESA records

2.1. Occupational Electrocutions

From 1998 to 2004, Ontario has seen 52 occupational electrocutions, an average of approximately seven electrocutions per annum (see Figure 1). Figure 3 shows an increase in prevalence of occupational electrocution, registering as 44% of all electrocutions in 1998, and rising steadily to over 80% in 2004. The rise in the prevalence of occupational electrocutions seems to correspond with WSIB records. WSIB showed traumatic[8] occupational fatalities rising from 114 in 1998 to 140 in 2003[9], an increase of 23%. Thus, the shift of prevalence from non-occupational to occupational electrocution continues.

Figure 3
Prevalence of Occupational Electrocution[10]
1998-2003



The trend of prevalence of occupational electrocution seems to continue in 2004. Only in 1998, was the prevalence of occupational electrocutions equal to that of non-occupational.

[8] Traumatic fatalities are defined as sudden and usually violent death.
[9] http://www.wsib.on.ca/wsib/wsibsite.nsf/LookupFiles/DownloadableFile2003StatisticalSupplement/$File/SS2003.pdf
[10] Based on ESA records

Comparing Ontario against other provinces, Table 1 and Figure 4 illustrates the distribution of occupational electrical fatalities across Canada for *firms registered with their respective WSIB*s[11].

Figure 4
Occupational Electrocutions
WSIB Registered Firms[12]
2001-2003

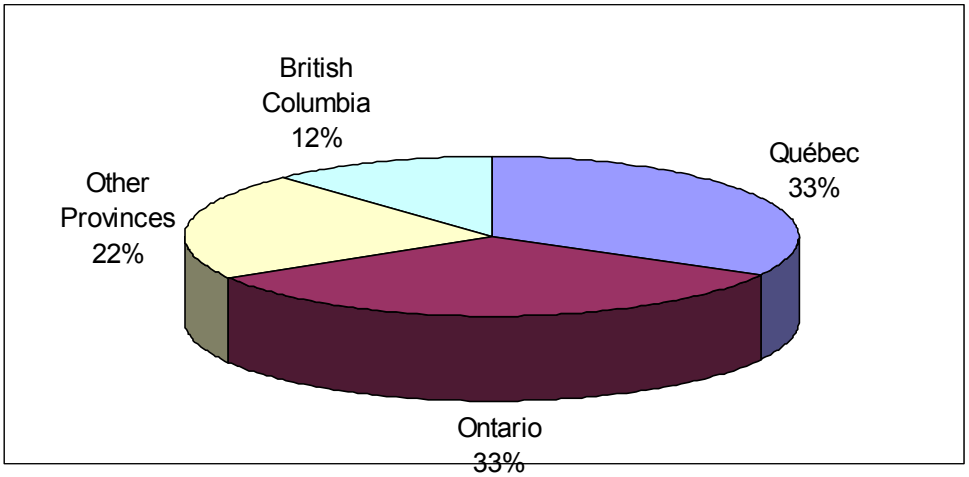


Table 1
Occupational Electrocutions-Selected Province[13]
2001-2003

	# of Fatalities 2001-2003	# of Fatalities 2000-2001	% of Electrical Fatalities 2001-2003
Ontario	14	9	33%
Quebec	14	6	33%
British Columbia	5	1	12%
Other Provinces	9	3	22%

[11] Please note that the number of electrocution reported by the NWIS is different from ESA count (10 fatalities versus 21 respectively).
[12] Based on NSIB records
[13] Based on NSIB records

In 2000 and 2001, Ontario represented 50% of all occupational electrocutions in the country with 9 electrocution incidents. In 2001 to 2003, Ontario only accounted for 33% of all Canada's electrocutions with 14 incidents. The drop in the prevalence can perhaps be attributed to better reporting from other provinces since the number of electrocutions in Ontario according the NWIS has changed very little in the 4-year span. The number of reported occupational fatalities to the WSIBs in other provinces in Canada increased from 3 to 9 between the period 2000- 2001 and 2001-2003[14] respectively (see Table 1).

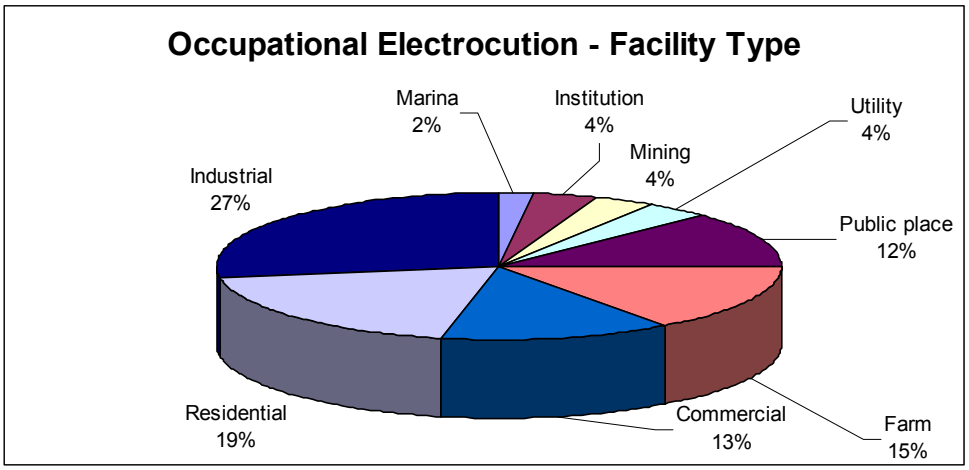
Table 2
Top Five Facilities in Occupational Electrocutions[15]
1998-2004

Facilities	Occurrences	Percentage by Facilities
Industrial	14	27%
Residential	10	19%
Commercial	7	14%
Farm	8	15%
Public place	6	12%
Others	7	13%

The prevalence of occupational electrocutions when sorted according to facility type has not changed significantly from the 2003 ESA Safety Report. Industrial, residential, commercial and farming accounted for most occupational electrocutions (Figure 5 and Table 2).

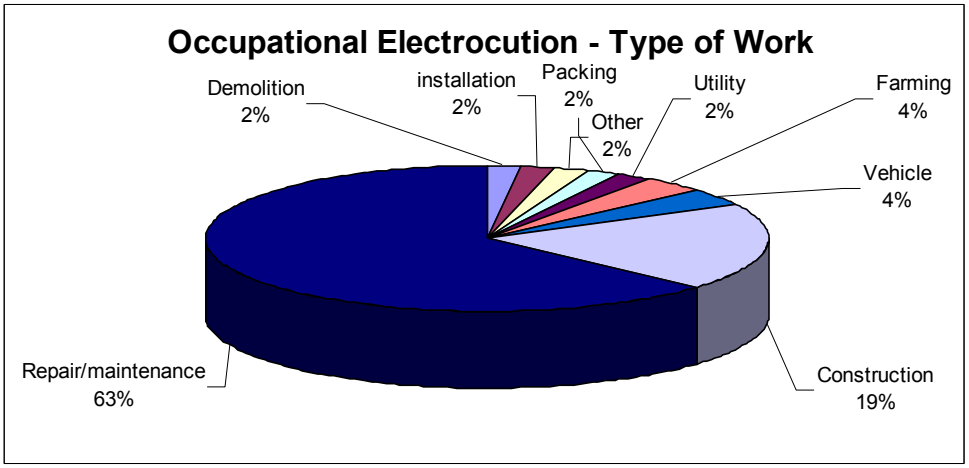
[14] ESA realizes that it is looking at a two and a three-year period respectively. However, the number of fatality reported more than doubled in the three year period.
[15] Based on Coroner's records

Figure 5
Occupational Electrocution – Facility Type[16]
1998-2004



Repair/maintenance type work accounted for more than 60% of all occupational electrocutions. Together, with construction, these two types of work make-up over 80% of electrocution cases at workplaces.

Figure 6
Electrocution by Project-Type[17]
1998-2004

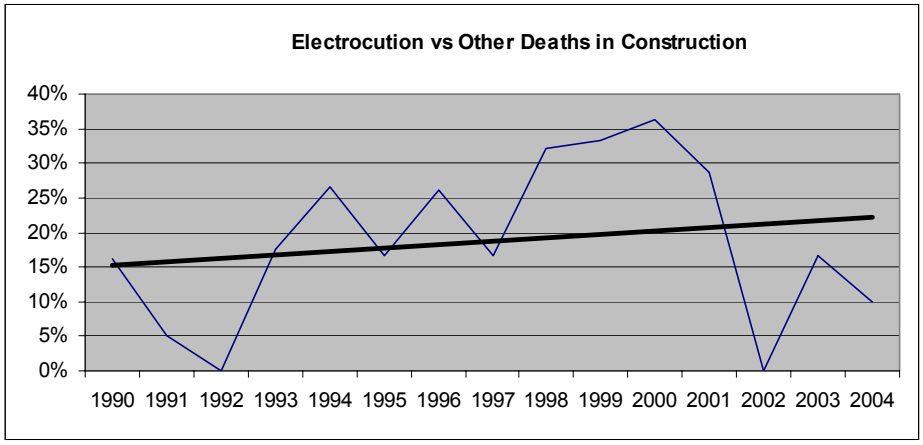


[16] Based on Coroner's records
[17] Based on Coroner's records

Repair/maintenance type work accounted for more than 60% of all occupational electrocutions

Figure 7 showed a decrease in the prevalence of electrocution incidents in the construction sector in the last three years. The number of construction electrocutions in 2002, 2003 and 2004 were 0, 5 and 2 respectively[18]. In 2004, electrocution accounted for only 10% of all construction deaths.

Figure 7
Electrocutions vs Total Deaths
In Ontario Construction[19]
1990-2004



From the description of fatalities, 65% of electrocutions in the workplace is the direct result of incorrect procedure (Figure 8), either lack or work planning or hazard awareness. The percentage of work practices that appeared non-compliant to the Occupational Health and Safety Regulations were the same as electrocution cases that showed lack of proper planning and hazard awareness.

[18] Based on CSAO data
[19] Based on CSAO records

Figure 8
Occupational Electrocution – Probable Cause[20]
1998-2003

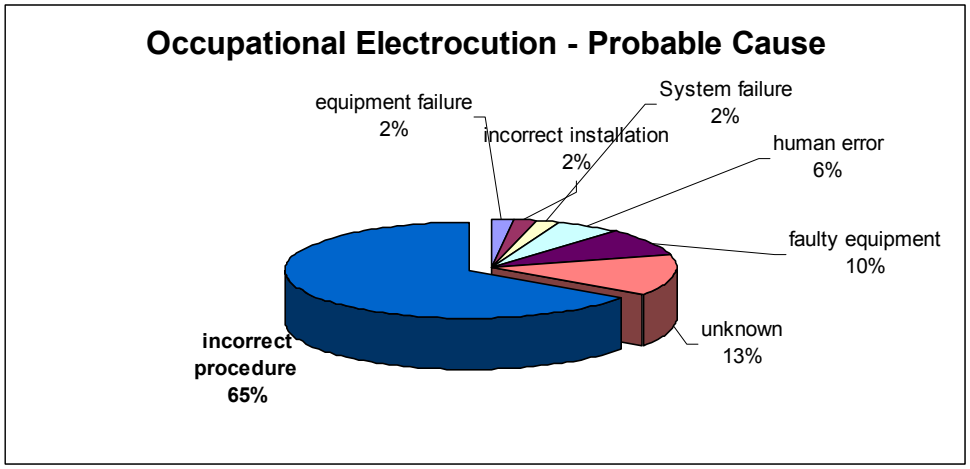


Figure 9
Occupational Electrocution - Occupation[21]
1998-2004

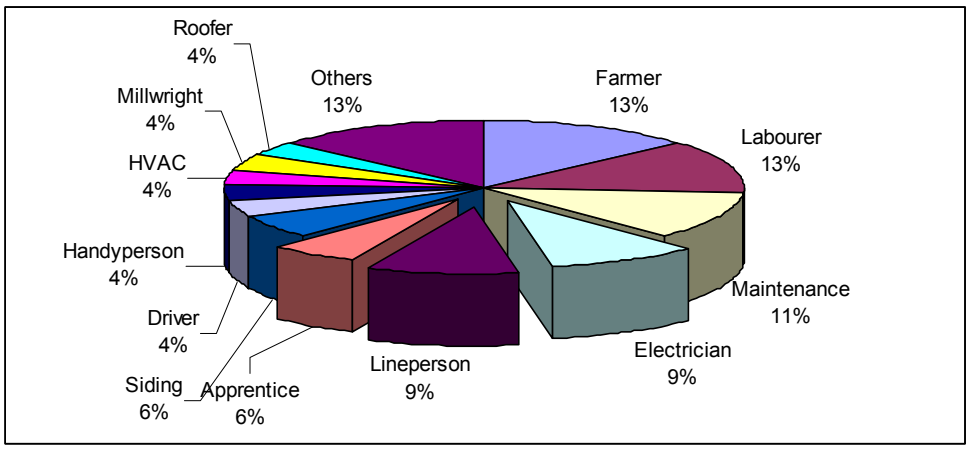


Figure 9 showed electrocutions between 1998 and 2004 sorted by occupation. As stated in previous ESA reports, electrocution impacts workers in a number of different occupations. Farmers, labourers and maintenance workers had the highest prevalence of all occupations. However, workers with formal education in

[20] Based on ESA records
[21] Based on Coroner's records

electricity (electricians, linepersons and apprentices) accounted for 24% (13 incidents) of all occupational death of electrical nature.

Figure 10
Occupational Fatalities – Likely Cause - MOL[22]
1998-2004

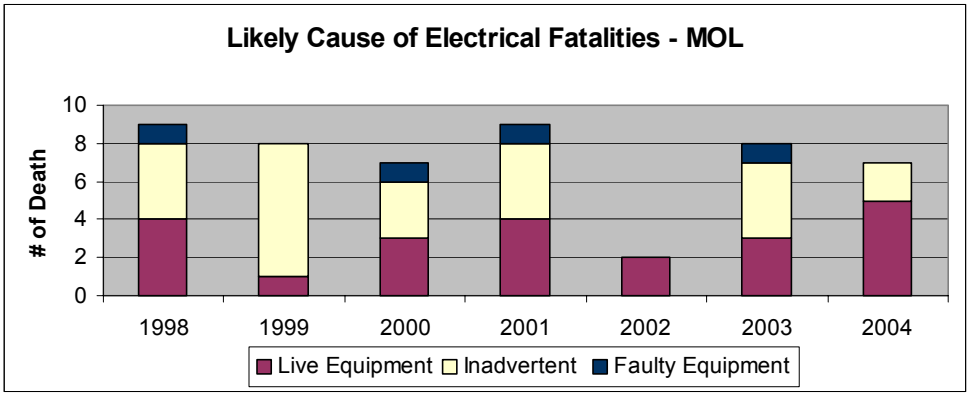


Figure 10 shows an increase of electrocution incidents with workers being aware that they were working with energized equipment while there is a decrease in incidents involving inadvertent contact. The trend in 2004 continues; where 5 of 7 electrocution incidents involved working live. There was no electrocution in that period that caused by working with faulty equipment.

There is an increase of electrocution incidents with workers being aware that they were working with energized equipment

[22] Based on MOL records

Figure 11
Electrocution - Electrical Trade[23]
1998-2004

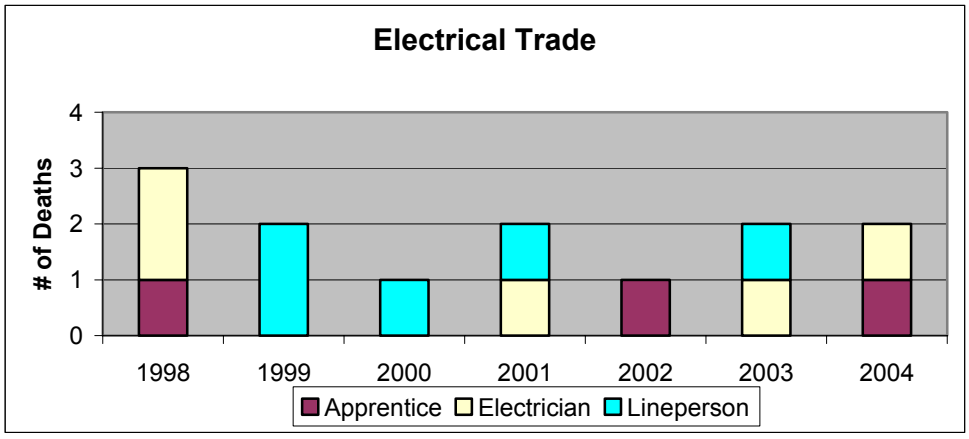


Figure 11 shows yearly deaths of electrical tradesmen from 1998 -2004. Each year, there is at least one death involving a worker with electrical training. Tabular form of Figure 11 can be seen on Table 3. Linepersons and electricians each have 5 fatalities for the time period. Each year, Ontario sees average almost two deaths of workers skilled in electrical work.

Workers with formal education in electricity (electricians, linepersons and apprentices) accounted for 24% (13 incidents) of all occupational death of electrical nature.

Table 3
Electrical Tradesperson – Electrocution[24]
1998-2004

Occupation	1998	1999	2000	2001	2002	2003	2004	Grand Total
Apprentice	1				1		1	3
Electrician	2			1		1	1	5
Lineperson		2	1	1		1		5
Total	3	2	1	2	1	2	2	13

[23] Based on ESA records
[24] Based on ESA records

The following are quick facts on occupational electrocutions:

Trends:

- Thirty-four of fifty-two occupational fatalities did not have a safe work procedure for their task that led them into their deaths.
- Sixty-seven percent of the fatalities seems to show non-compliance with the Ontario Health and Safety Act and Regulations.
- More than half of the electrocutions involved powerline contact (28 incidents).
- Residential fatalities continue to show that victims did not have any type of safe work procedure for their tasks.
- Maintenance/repair workers were electrocuted mainly indoors when repairing wiring, machines or electrical panels. More than half were unaware they were working with energized equipment.
- Handymen fatalities indicated that the workers were unaware that the line they contacted were energized. Fatalities with handymen involved voltage less than 750 Volts.
- Most farmer fatalities were the result of overhead wire contact (80%). They involved small family farms, non-dairy and occurred in western Ontario, where farming is prevalent.
- Labourer's fatalities were mostly ladder related, involving overhead wire contact.
- Electrician's fatalities indicated that the workers were aware they were working with energized equipment.
- 347 Volt lighting fatalities indicated that the workers were aware they were working with an energized system.
- Electrocution from faulty equipment only constituted 10 % of occupational fatalities.

- Roughly 15% of occupational fatalities indicated that the victims were aware they were working with energized equipment. Coroner's record is substantiated by the MOL findings as seen below.
- Approximately half of occupational fatalities indicated lack of awareness of either the presence of overhead powerline in the vicinity or the electrical system being energized by the victims.

Farmer fatalities were the result mostly of overhead wire contact (80%). They involved small family farms, non-dairy and occurred in western Ontario, where farming is prevalent.

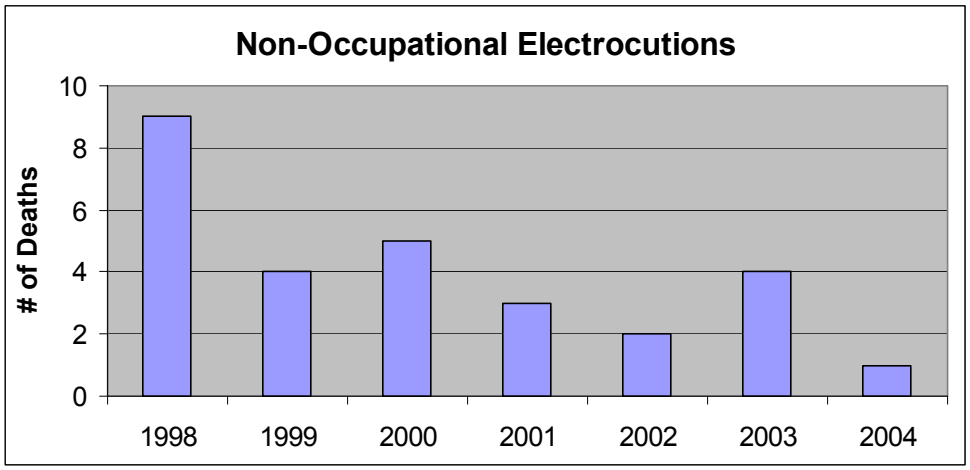
2004 Occupational Fatalities

- Six of seven occupational fatalities involved workers working alone.
- Five fatalities indicated that the workers knew they were working live.
- There were only two powerline fatalities, contrary to previous years where powerline fatality incidents were at least equal to or greater than non-powerline fatalities.
- Two fatalities involved seasoned tradepersons, who had been performing the same tasks safely for years.
- There was one 347 Volt lighting death in 2004. It did not involve an electrician.

2.2. Non-Occupational Electrocutions

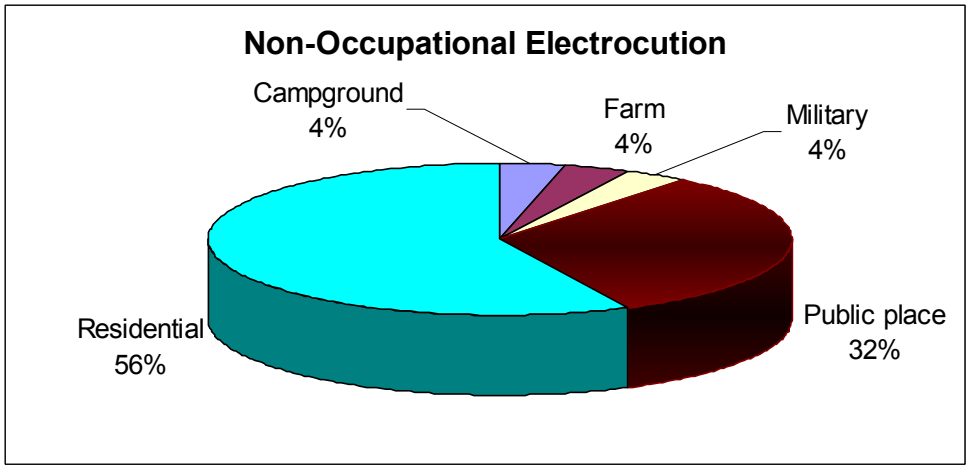
There were a total of 28 non-occupational electrocutions between 1998 and 2004. The decline of non-occupational electrocutions continues with only one non-occupational death in 2004, a male (Figure 12). Thus, the count of female electrocution remains at 5 compared to 23 males in the 1998 to 2004 period.

Figure 12
Non-Occupational Electrocution[25]
1998-2004



Residential facilities continue to appear prominent in non-occupational electrocutions, though its prevalence decreased slightly with only one death in residential in 2004. Public places[26] accounted for another 32% (Figure 13).

Figure 13
Non-Occupational Electrocution – Facility Type[27]
1998-2004



[25] Based on Coroners records
[26] ESA revised the definition of public places in this report. While marinas were separately classified in previous years, the 2004 report considers marina as a public place.
[27] Based on Coroners records

From 28 electrocution incidents in non-occupational setting, powerline electrocution accounted for 17 of them (61%). More than half of the powerline electrocutions (9 occurrences) were in residential facilities, followed by public places at 7 occurrences (Figure 14).

From 28 electrocution incidents in non-occupational setting, powerline electrocution accounted for 17 of them (63%)

Figure 14
Non-Occupational Electrocution - Powerline[28]
1998-2004

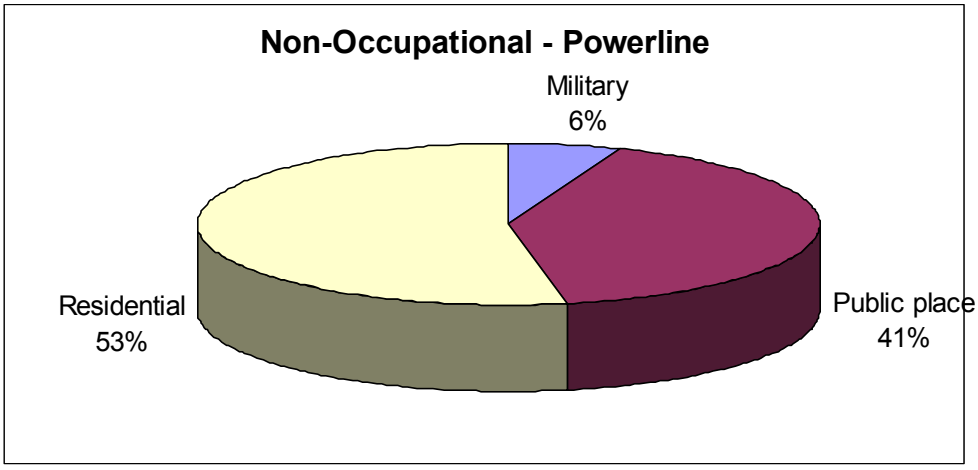
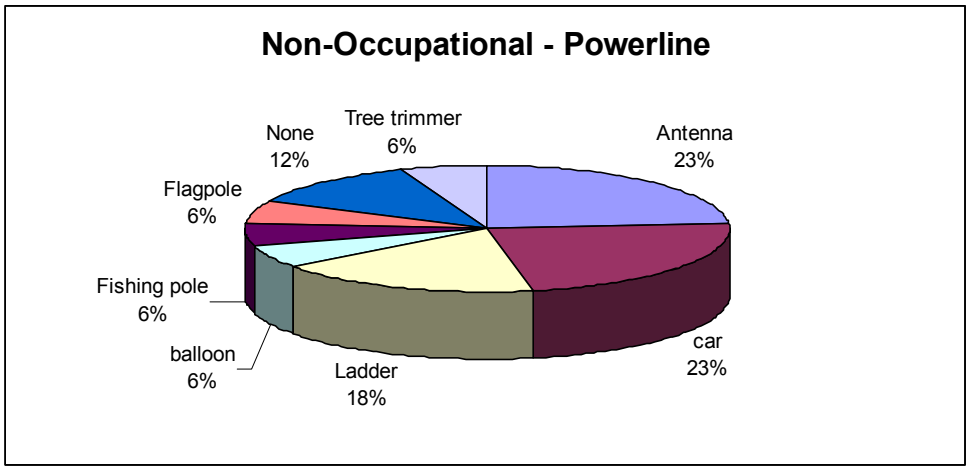


Figure 14 illustrates the predominance of residential and public places in powerline fatalities of non-occupational nature. The two types of facilities accounted for 94% of powerline fatalities in non-occupational sector.

[28] Based on Coroners record

Figure 15
Non-Occupational – Powerline
Equipment Used
1998-2004



Antennas, car and ladders are most predominant in non-occupational powerline fatalities, accounting for 64% of incidents of this nature (Figure 15). The rest were one or two incidents with equipment or devices such as a fishing pole, flagpole, and tree trimmer. Nine of the powerline electrocutions occurred during 'recreation' activities.

3.0. Occupational Injuries and Utility Related Incidents

3.1. Occupational Injuries

The MOL injury data showed the same trend as WSIB in its occupational injuries, displaying the same contour of rise and fall of injury counts, at the same years. WSIB electrical incidents can be seen on Figure 16.

Figure 16
WSIB – Occupational Injuries[29]
1998-2003

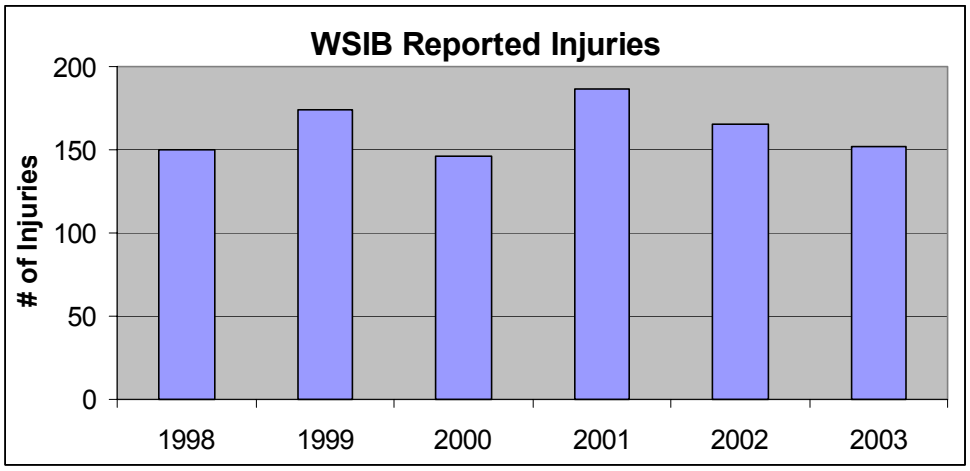


Figure 17
Critical Injuries Reported to MOL – Most Likely Cause[30]
1998-2004

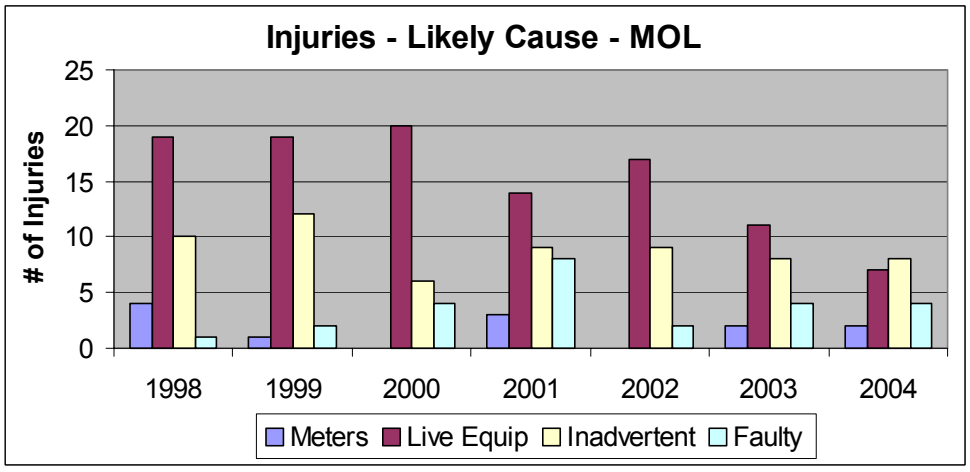
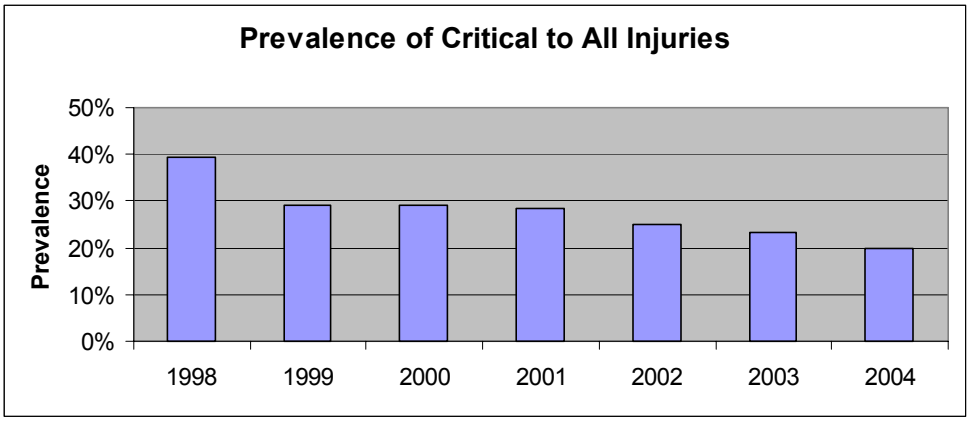


Figure 17 shows a decreasing trend of injuries when working on energized equipment. The number of incidents of inadvertent contact with electrical current remained relatively the same, as so did meter injuries. The number of faulty equipment injuries was relatively small compared to live equipment and

[29] Based on NWIS records
[30] Based on MOL records

inadvertent contact incidents. MOL cited that almost half of electrical deaths and injuries were the direct result of knowingly working 'live'[31]

Figure 18
Prevalence of Critical Injuries[32]
1998-2004



The ratio of critical to all electrical injuries is declining between 1998 and 2004 according to MOL records. While the overall injury count remained relatively the same for the period (around 100), the prevalence of critical injuries has decreased from 40% in 1998 to 20% in 2004, a decline of 50% (Figure 18). *ESA reported 4 incidents in 2004 with 347-Volt lighting system and 2 incidents involving multimeters that resulted in critical injuries.*

MOL cited that almost half of electrical deaths and injuries were the direct result of knowingly working 'live'

[31] MOL, Electrical Incidents and Occurrences, Annual Summary for 2004
[32] Based on MOL records

Figure 19
Non Critical Injuries – MOL[33]
1998-2004

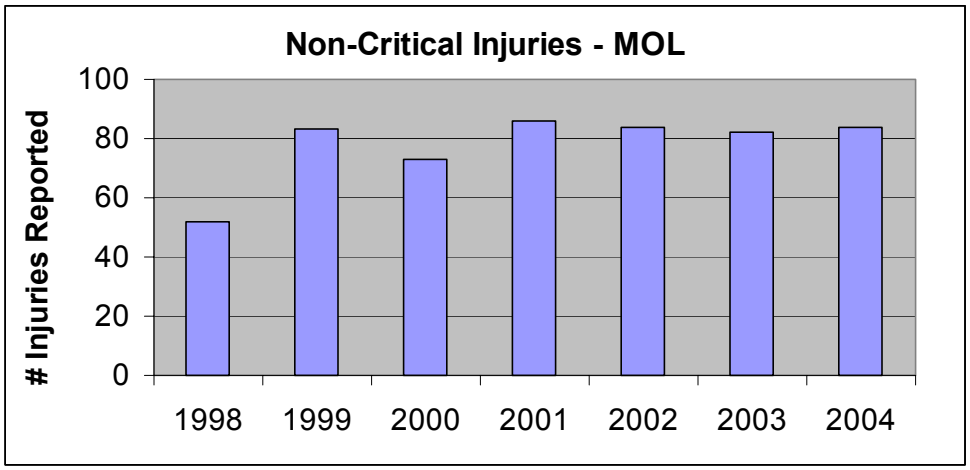
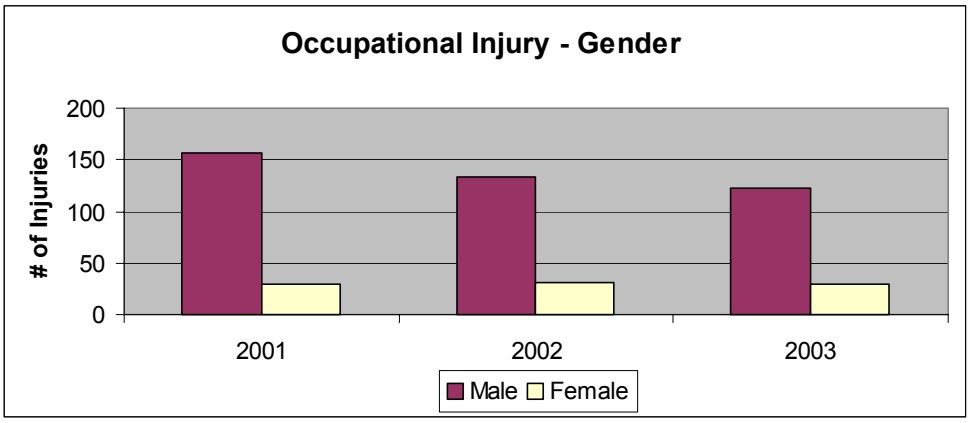


Figure 19 shows the number on non-critical injuries reported to the MOL. When the NWIS figures (Figure 16) are compared to that of the MOL's (Figure 17), they seem to correspond. The NWIS for 1998-2004 shows a 'bow' shape as a trend, peaking in year 2001 and declining in 2002 and 2003. The MOL does not show such a dramatic bow, but 2001 accounted for the highest number of injuries reported for the period.

[33] Based on MOL records

Figure 20
Occupational Injuries – Gender
2001-2003[34]



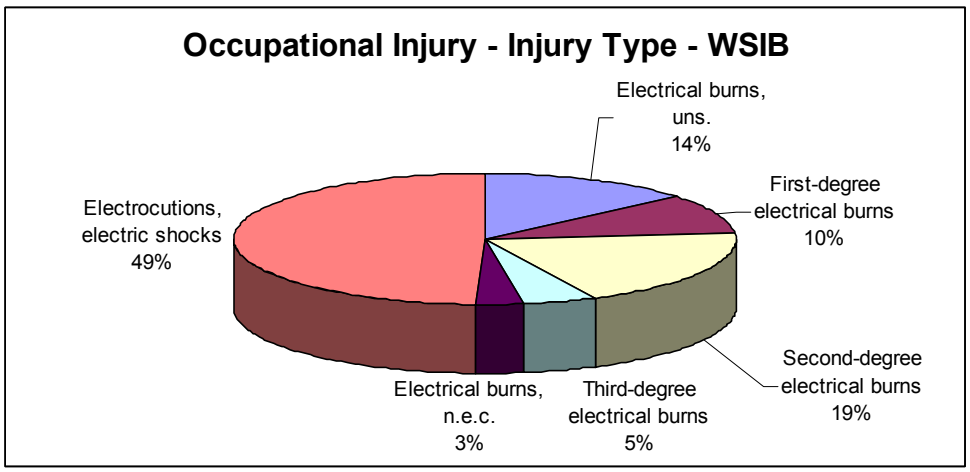
According to the NWIS data, Ontario occupational injury incidents of electrical nature involving women did not change between 2001 and 2003 (Figure 20). They remained around 30 injuries per annum. Male injuries showed a decline from just over 150 in 2001 to 125 in 2003.

Table 5 **NWIS Electrical Injuries According to Industries** **2003**	
Office furniture industries	3
Fabricated structural metal products industries	3
Other metal fabricating industries	3
Exterior close-in work	3
Electric power systems industry	3
Other machinery and equipment industries	4
Electrical industrial equipment industries	4
Plumbing, heating and air conditioning, mechanical work	4
Hospitals	4
Stamped, pressed and coated metal products industries	6
Motor vehicle parts and accessories industries	6
Not coded	7
Electrical work	17
Food services	21
Total	152

[34] Based on NWIS records

Electrical injuries according to industry can be seen on Table 5. Displayed on the table are industries with 3 or more incidents. The profile of industry is typical for 2001 –2003. Figure 21 illustrates the type of injuries of electrical nature in occupational setting. Please note that NWIS also defines injuries from electrical contact as "electrocution"[35], explaining the large prevalence of occupational electrocutions in the NWIS data.

Figure 21
Occupational Injuries
2001-2003



3.2. Electrical Distribution Related Incidents

There were a total of 62 incidents involving electrical distribution in the period between 1998 and 2004 that were reported to ESA. Forty-eight of those incidents or 76% resulted in fatalities (Figure 22).

While electrocutions involving electrical distribution equipment represented 60% of all electrocutions in Ontario between 1998 and 2004, powerline fatalities (46 incidents) accounted for 58% of total electrocutions in Ontario. Thus, most fatalities involving distribution equipment are powerline related.

[35] Contrary to what the definition of electrocution in the dictionary, which means death by electrical contact

There were 28 occupational-related powerline fatalities in this period – in other words, 60% of powerline electrocutions occurred in the workplace.

The MOL reported 896 occupational powerline contacts for the same period. Taking the ratio of reported occupational powerline contact and fatalities, 3.1% of powerline contact resulted in a fatality.

60% of powerline electrocutions occurred in the workplace

Figure 22
Electricity Distribution Related Incidents[36]
1998-2004

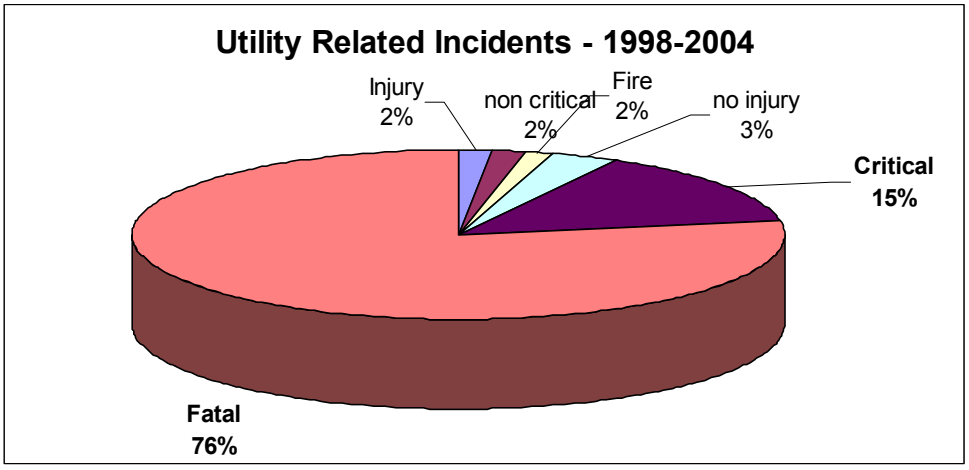


Table 6 shows the breakdown of the type of incidents that were investigated by ESA. The table provided actual incident count of Figure 22.

[36] Based on ESA records

Table 6
Summary of Utility Incidents[37]
1998-2004

Type of Occurrence	Powerline	Other Utility	Total
Fire	0	1	1
No Injury	2		2
Injury non critical	1	1	2
Critical Injury	6	3	9
Fatality	46	2	48
Grand Total	55	7	62

Year-to-year count of powerline contact as reported by the MOL can be seen on Figure 23. The graph clearly illustrates the rise of powerline contact incidents in Ontario (almost 50% from 1998 to 2004, from 108 to 151 incidents), which can possibly be attributed to better reporting to MOL.

Figure 23
Total Powerline Contact[38]
1998-2004

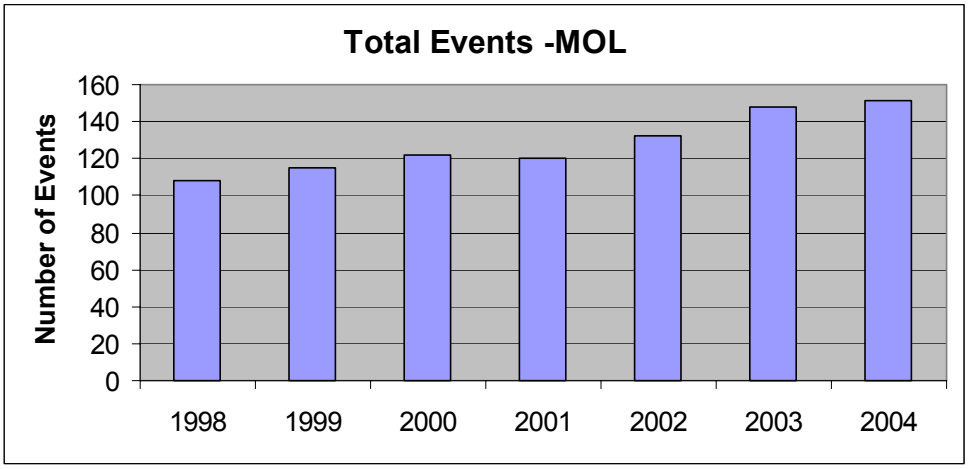
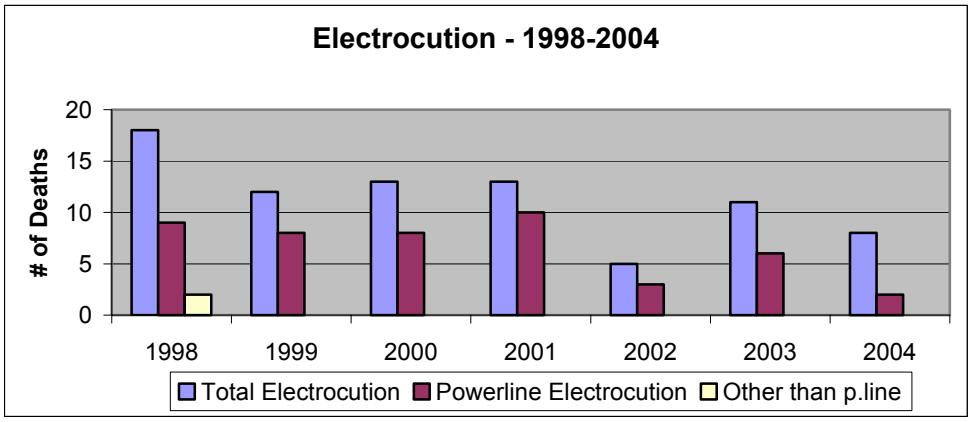


Figure 24 shows a comparison between powerline electrocution and total electrocution in the period of 1998 to 2004.

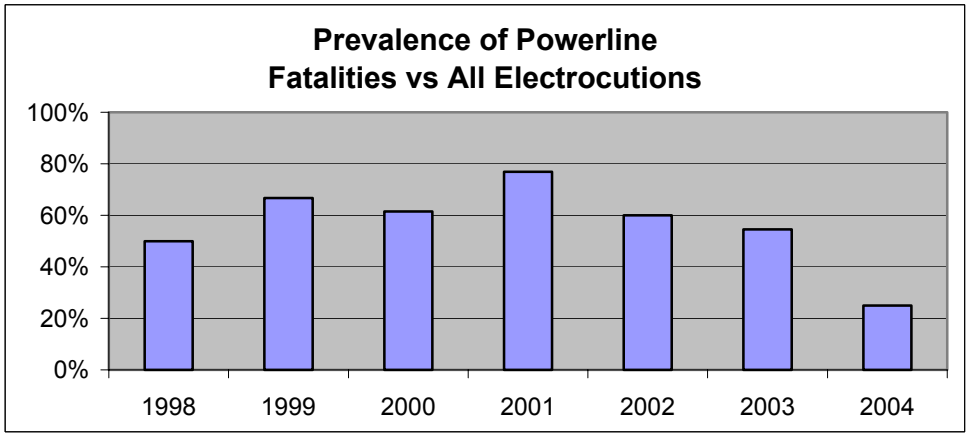
[37] Based on ESA records
[38] Based on MOL records

Figure 24
Electrocution[39]
1998-2004



Further comparison is performed by comparing at the prevalence of powerline fatalities (Figure 25) and the total electrocutions in the province. The last two years clearly shows a decline in frequency of deaths involving powerline. For the first time in 7 years, 2004 powerline fatality count was below 50% of total electrocution in the province.

Figure 25
Prevalence of Powerline Electrocution[40]
1998-2004



[39] Based on ESA records, "other than powerline" are – deaths at transformer stations and vehicle related
[40] Based on ESA records

Figure 26
Powerline Electrocution – Occupation[41]
1998-2004

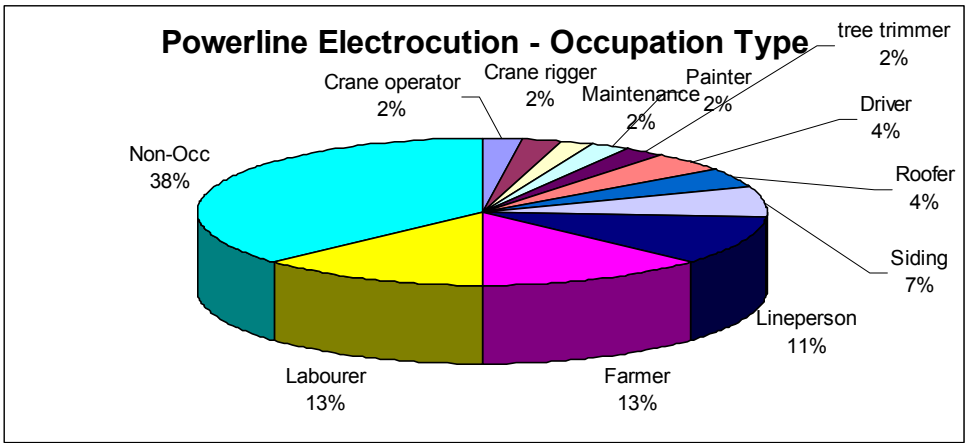
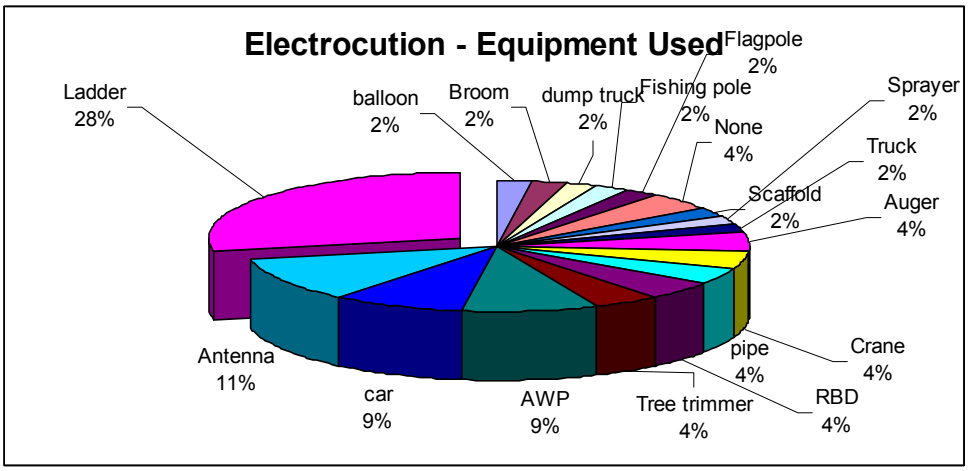


Figure 26 shows the profile of powerline electrocutions when sorted by occupation. For 1998 to 2004, labourers, farmers and linepersons had the most fatalities of all occupations. However, as shown in ESA's previous safety reports, powerline electrocutions are not restricted to one or two occupations alone.

Figure 27
Powerline Electrocution – Equipment Used[42]
1998-2004



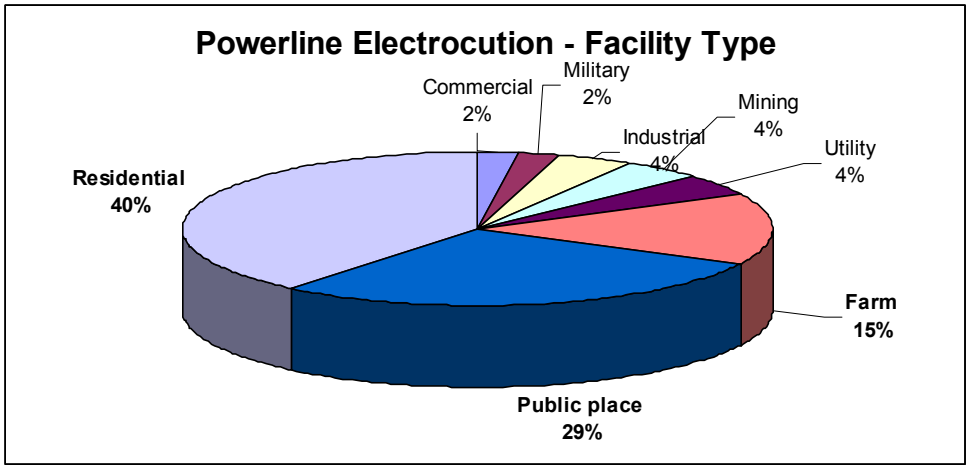
[41] Based on ESA records
[42] Based on ESA records

Note on Figure 27
AWP – Aerial Work Platform
RBD – Radial Boom Derrick

Ladders continue to be the most predominant equipment used in powerline deaths at 28% (Figure 27). The prevalence of ladder electrocution has decreased slightly from ESA's last year's report. This can be attributed to no ladder fatalities in 2004. As in previous years, aside from ladders, there has really been no single dominant equipment used when electrocution occurred involving powerline.

Ladders continue to be the most predominant equipment used in powerline deaths at 28% despite no deaths in 2004.

Figure 28
Poweline Electrocution – Facility Type[43]
1998-2004



When sorted according to facility-type, residential sites were most prevalent in powerline electrocutions in the 1998-2004 period (40%, see Figure 28). Next are public places at 29% and farms at 15%. From the 18 electrocutions in residential sites, nine were non-occupational in nature. Further breakdown of the fatalities in residential sites can be seen on Table 7. From the eighteen fatalities, fifteen incidents (83%) indicated incorrect work procedure as the probable cause of the electrocutions. In all these fatalities, only two incidents indicated that visibility

[43] Based on ESA records

was a problem. In these two incidents, the victims were working amongst the trees, where clear sight to the energized powerline may have been hindered by foliage.

Table 7
Residential Powerline Electrocution[44]
1998-2004

Occupation	Occurrences	Percentage
Driver	1	6%
Roofer	1	6%
Tree trimmer	1	6%
Labourer	3	17%
Siding	3	17%
Non- Occupational	9	50%
	18	

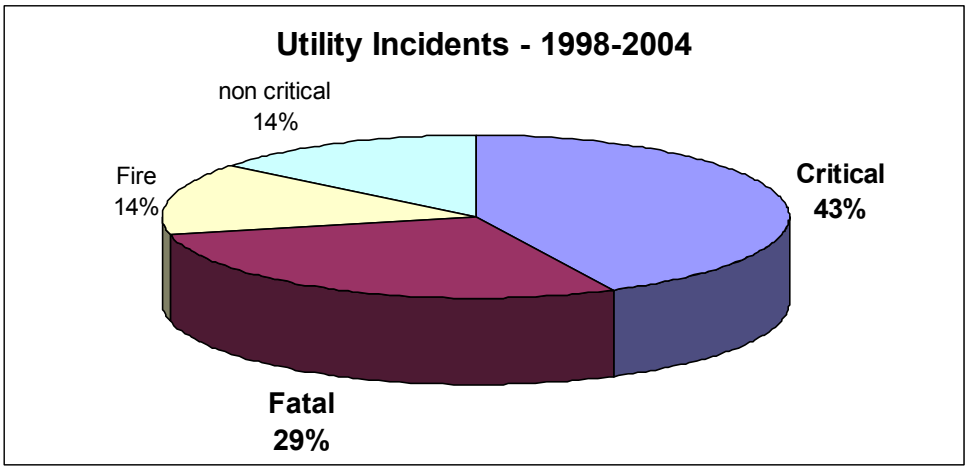
3.2.1. Electrical Distribution Incidents Other than Powerline

There were 7 reported incidents involving distribution that are non-overhead powerline related in the 1998-2004 period. As can be seen on Figure 29, seventy-two percent of the incident resulted either in a fatality or injury. Two fatalities were the result of pranks, teenage boys trying to get into the transformer stations and were electrocuted as a result.

One electrocution involving electrical utility infrastructure was a vehicle fatality. There were no occupational related fatalities in the 1998-2004.

[44] Based on ESA records

Figure 29
Utility Incidents – Non Powerline[45]
1998-2004



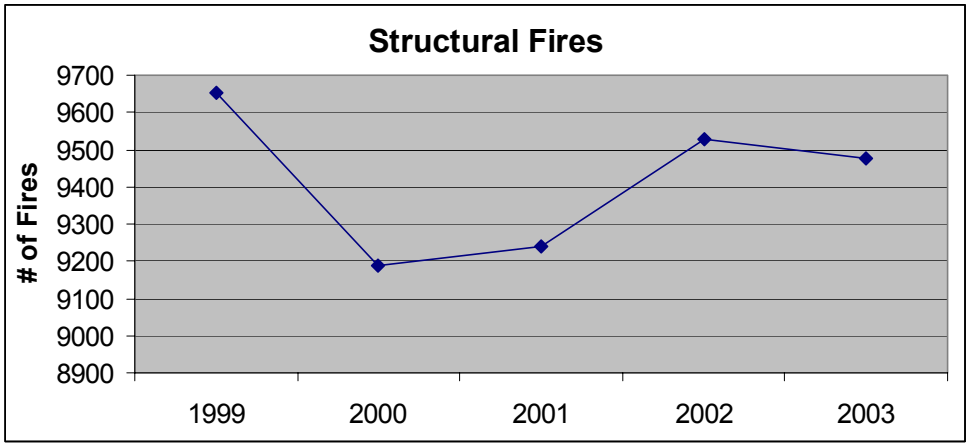
4.0. Electrical Related Fires

The number of total fires in Ontario reported to the OFM has decreased from 30,531 in 1999, to 27,832 in 2003, a decrease of 9%. The number of Loss Fire[46] for the same period has also decreased, from 18,538 incidents to 16,219 incidents. Loss fires constitute roughly 58% of all fires.

The number of structural fires in Ontario has decreased from 9,652 fires to 9,478 fires in 1999 and 2003 respectively (Figure 30). There was a slight increase in 2001, and this may be attributed to better fire reporting, an effort that OFM undertook that year to ensure that all fires are reported. Structural fires accounted for approximately 58%[47] of total Loss Fires in 2003.

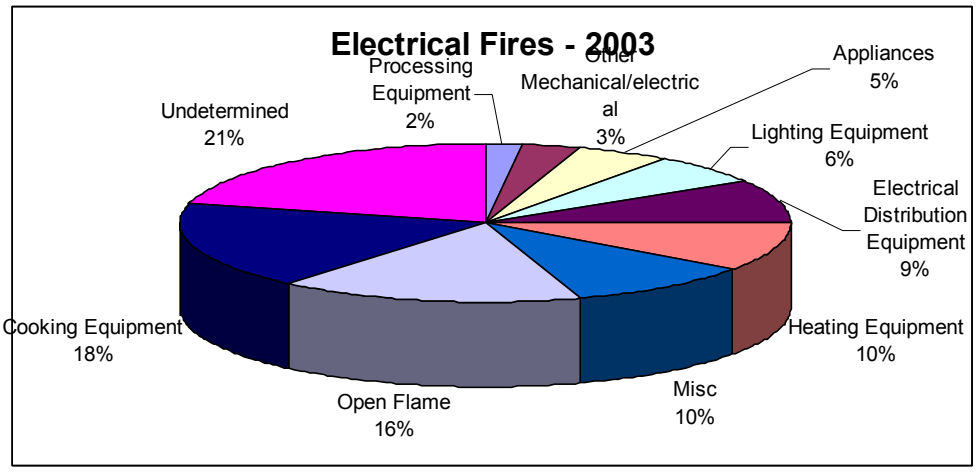
[45] Based on ESA records
[46] Loss Fire is defined by the OFM as fire with reported injury, fatalities or dollar cost as the result of the fire.
[47] The percentage of Loss Fires to total fires and structural fires to Loss Fires is the same, 58%, which is just a coincidence.

Figure 30
Ontario Structural Fires[48]
1999-2003



Ignition sources in structural fires can be seen in Figure 31. Ignition sources that are identified as powered by electricity are electrical distribution equipment, processing equipment, cooking equipment[49], appliances, lighting equipment and other electrical(mechanical not included)

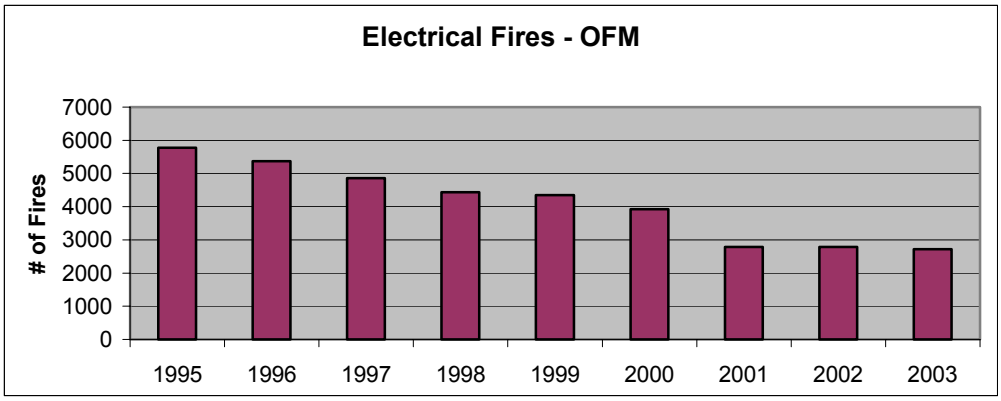
Figure 31
Ontario Structure Fires – Ignition Source – 2003



In 2003, three-quarters of fires in structures occurred in residential settings. Residential fires accounted for 77% of all fires (including vehicle fires) since 1995 (Figure 34). The number of electrical fires reported by the OFM where electricity was cited as the fuel has been declining as can be seen on Figure 32. In 2003, the number of electrical fires has been reduced by almost 50%.

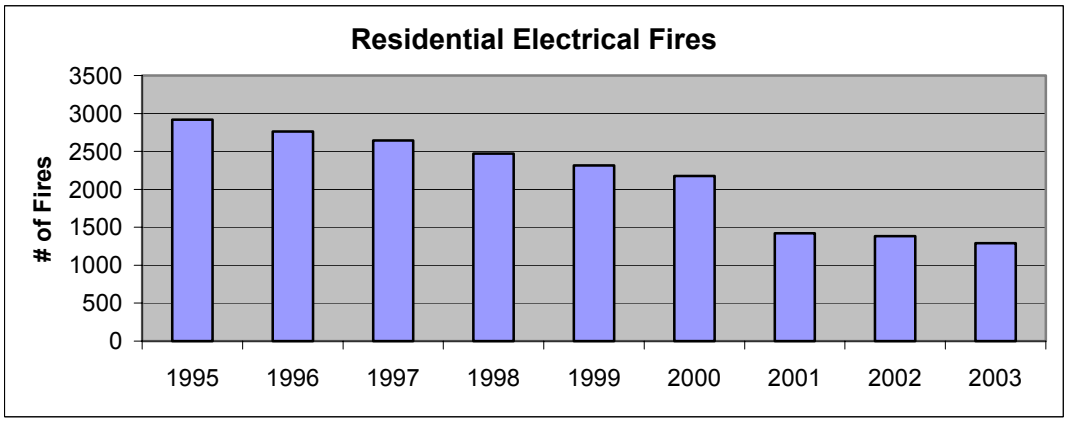
[48] Based on OFM records
[49] OFM considers most cooking equipment in Ontario are electrically powered.

Figure 32
Electrical Fires[50]
1995-2003



The same decline can be seen in residential fires (Figure 33). For the same period, fires of electrical nature were reduced from just fewer than 3,000 incidents in 1995 to around 1,300 incidents in 2003, a reduction of more than 50%.

Figure 33
Residential Electrical Fires[51]
1995-2003

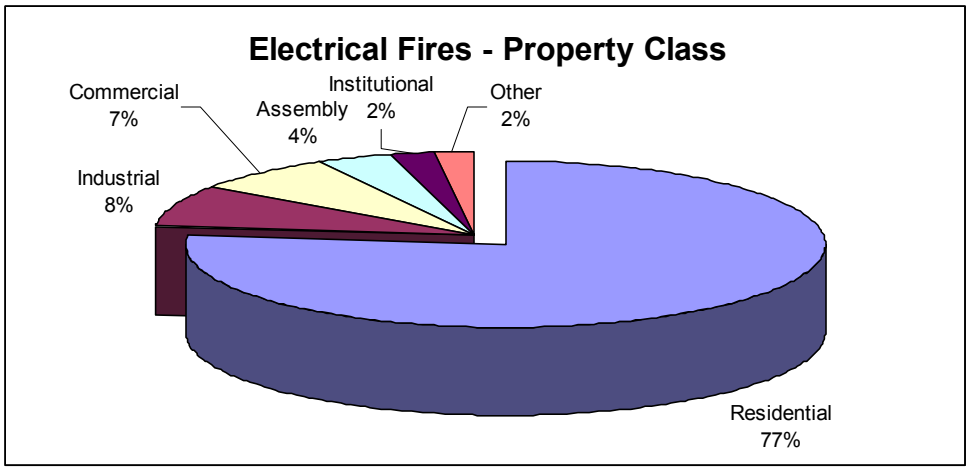


According to OFM, from 1999 to 2003, residential fires dropped from 6,916 fires to 6,801 fires. Again, in 2001, there was a slight increase in numbers of fire reported to the OFM, consistent with the pattern exhibited in the reporting of structural fires. Fire rate per 1000 building dropped from 1.86/1000 to 1.77/1000,

[50] Based on OFM records
[51] Based on OFM records

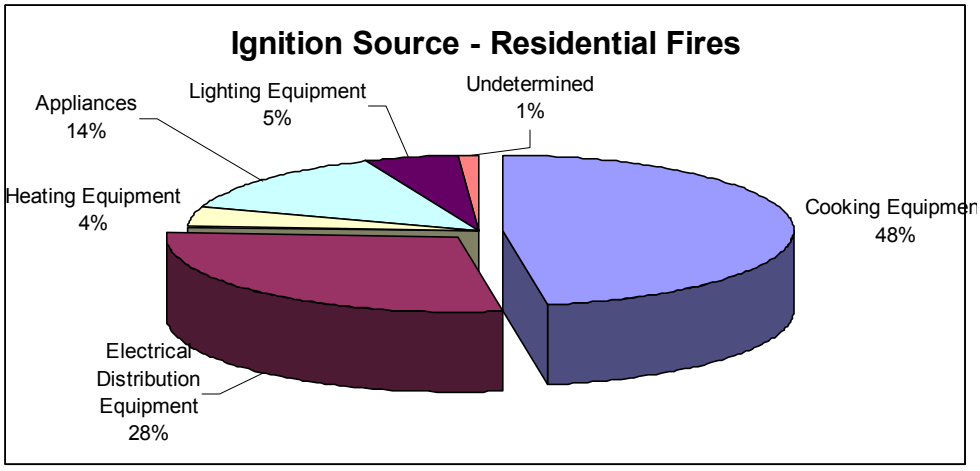
a drop of 4.8%. A quarter of all structural fires were started by electricity as fuel of ignition.

Figure 34
Electrical Fires – Property Class
1995-2003



Cooking equipment accounted for almost half of all residential fires as the ignition source while another quarter of the fires was ignited by distribution equipment (Figure 35).

Figure 35
Ignition Source – Residential Fires
1995-2003



Stoves and range tops accounted for most of cooking fires, with ovens as the next most prevalent cooking equipment that catches on fire (Figure 36).

Figure 36
Residential Fires – Cooking Appliance
1995-2003

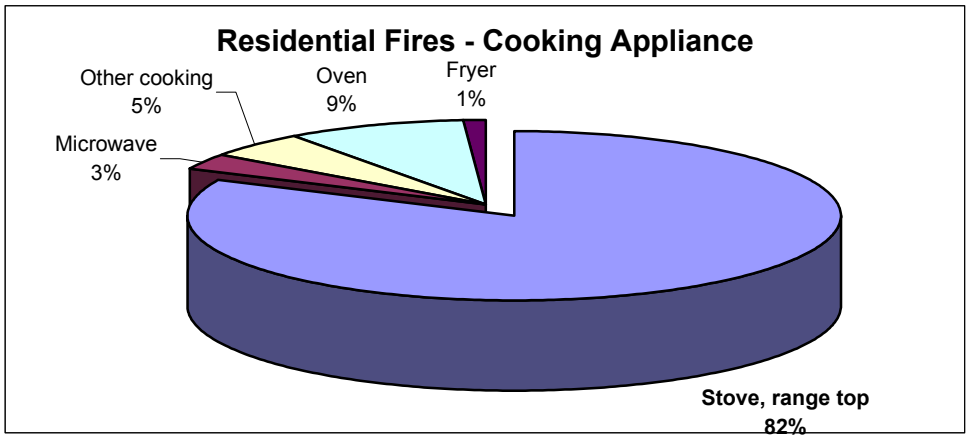
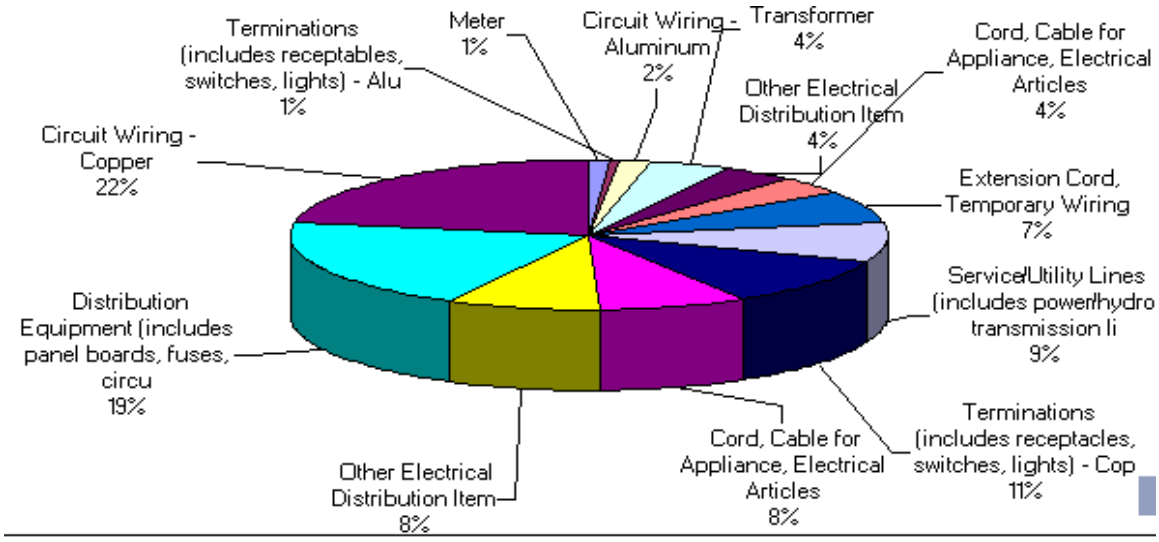


Figure 37
Electrical distribution equipment[52]
1995-2003



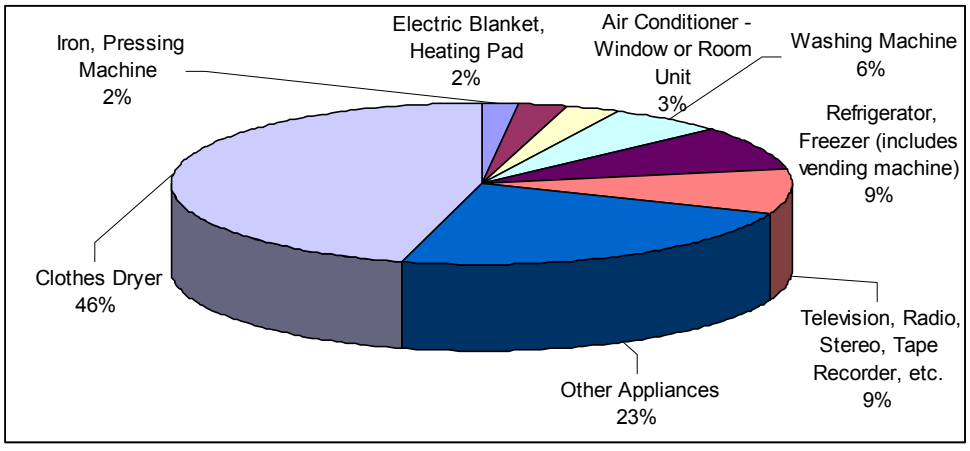
[52] Based on OFM records

As can be seen on Figure 37, circuit wiring and distribution equipment were the most common type of distribution equipment cited by the OFM. ESA investigation of fires in 2003 and 2004 revealed that incorrect installation and improper use of the equipment were the major reasons for the fires. For appliance fires, the breakdown can be seen on Table 8.

Table 8
Electrical Fires – Appliance[53]
1995-2003

Appliance	Occurrences
Clothes Dryer	1549
Other appliance	778
Television/radio, stereo	313
Refrigerator/freezer	198
Washing Machines	206
Air Conditioner	92
Electrical Blanket	82
Iron, pressing machines	67
Total	3378

Figure 38
Electrical Fires -Appliance[54]
1995-2003



[53] Based on OFM records
[54] Based on OFM records

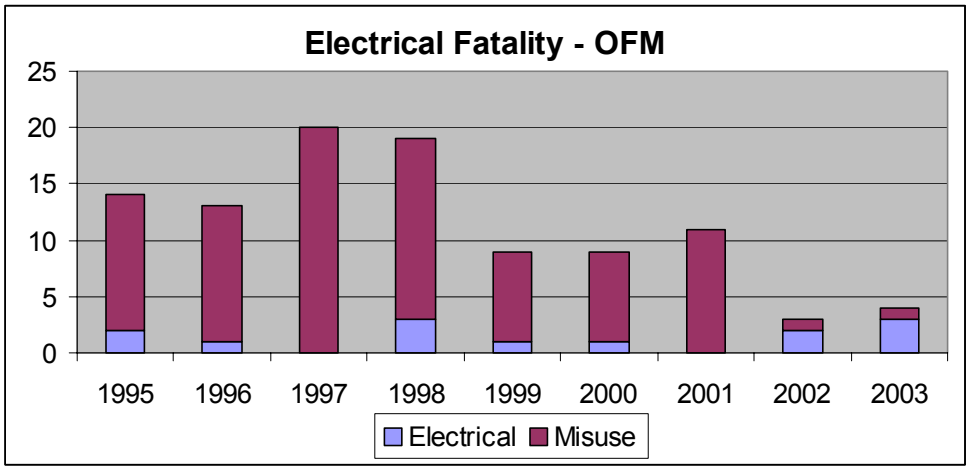
Figure 38 shows the graphic representation of Table 8. The figure clearly illustrates the prevalence of clothes dryer as the main cause of other electrical appliance fires.

4.1. Fire Fatalities – Electrical Origin

Fatalities associated with electricity can be seen on Figure 39. Though 1997 and 1998 saw high numbers of electrical fatalities, the number of fatalities with electricity as the source has been on a decline since then. 1995 saw fourteen electrical-related fatalities while in 2003, that number has dropped to four, a drop of over 70%.

Figure 39 also distinguishes deaths caused by misuse of electrical equipment/device and other causes. This figure clearly illustrates the dominance of misuse incidents in these deaths. Though the number of other electrical deaths has been the highest in the nine-year period, these numbers are very small. For example, in 2003, we saw 3 deaths caused by electricity not involving misuse.

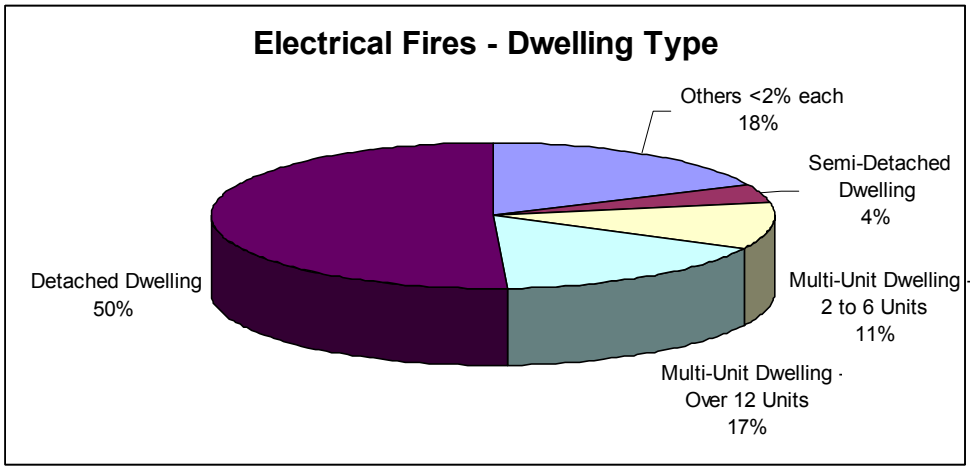
Figure 39
Electrical Fatalities –OFM[55]
1995-2003



[55] Based on OFM records

Fatalities of electrical nature have all occurred in dwellings (as opposed to vehicles or machines). This can be seen on Figure 40. Detached single dwelling accounted for 50% of all electrical fatalities and dwellings over 12 units accounting for another 17%.

Figure 40
Electrical Fatalities – Dwelling Type[56]
1995-2003

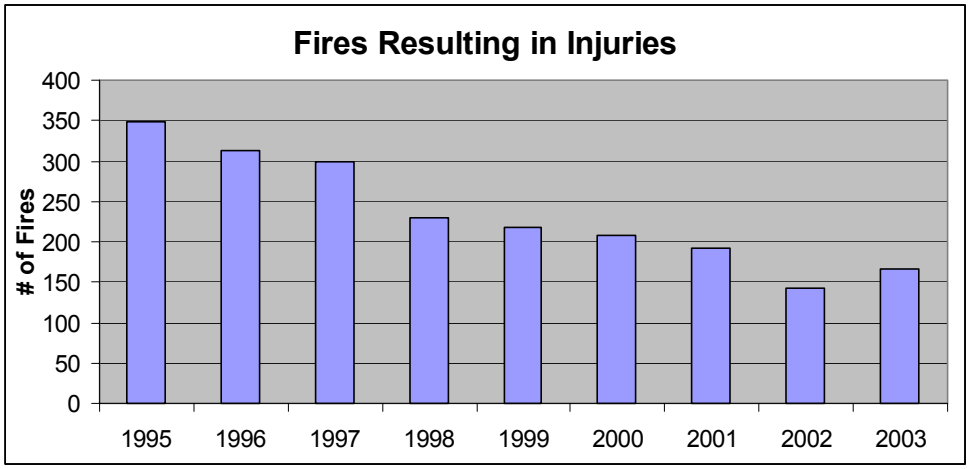


4.2. Fire Injuries – Electrical Origin

The OFM records indicated 2106 injuries as a result of electrical fires between 1995 and 2003. As with electrical fire fatalities, injuries as a result of electrical fires have also declined in the same period. The OFM record shows a decline from 350 injuries in 1995 to around 170 injuries in 2003, a decline of almost 50% (Figure 41).

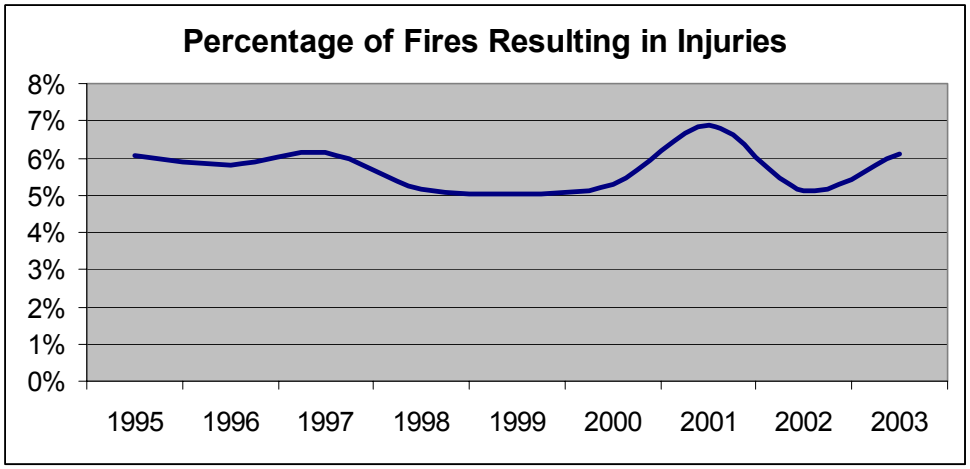
[56] Based on OFM records

Figure 41
Electrical Fires Resulting in Injuries[57]
1995-2003



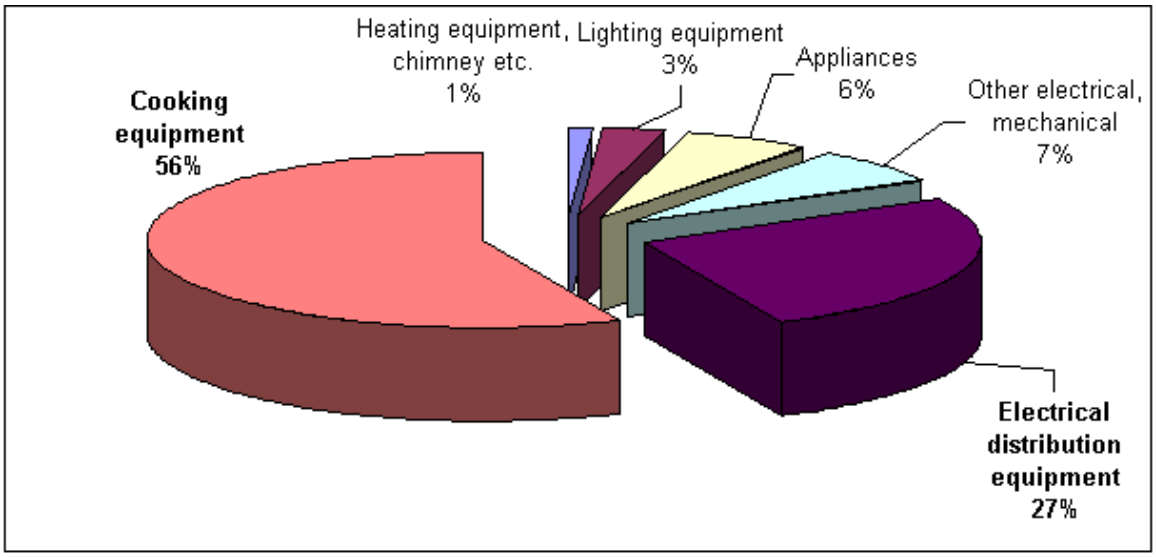
When the number of electrical fires is compared to the number of injuries, the percentage of fires that resulted in an injury has not changed (Figure 42). In short, for 100 electrical fires, we can expect to see six injuries.

Figure 42
Percentage of Injuries to Fires[58]
1995-2003



[57] Based on OFM records
[58] Based on OFM records

Figure 43
Fires - Electrical Injuries – Type of Equipment[59]
2003

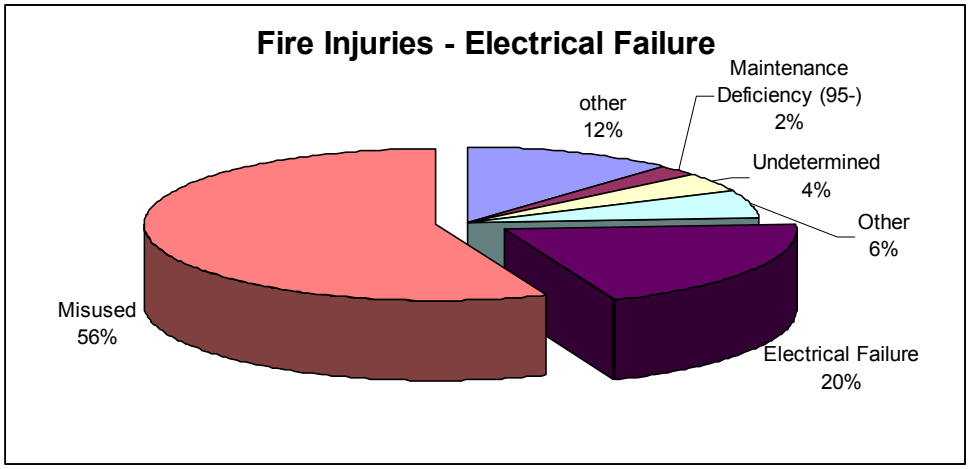


In 2003, cooking equipment was cited as the main ignition source for electrical fires resulting in injuries (see Figure 43). Electrical distribution equipment was the second most prevalent ignition source at 27%. Though previous years preceding 2003 are not shown, they showed the same profile in terms of ignition source.

Correspondingly, Figure 44 shows misuse as the main cause of the fires resulting in injuries, followed by electrical failure at 20%.

[59] Based on OFM records

Figure 44
Fire Injuries – Electrical Failure
1995-2003

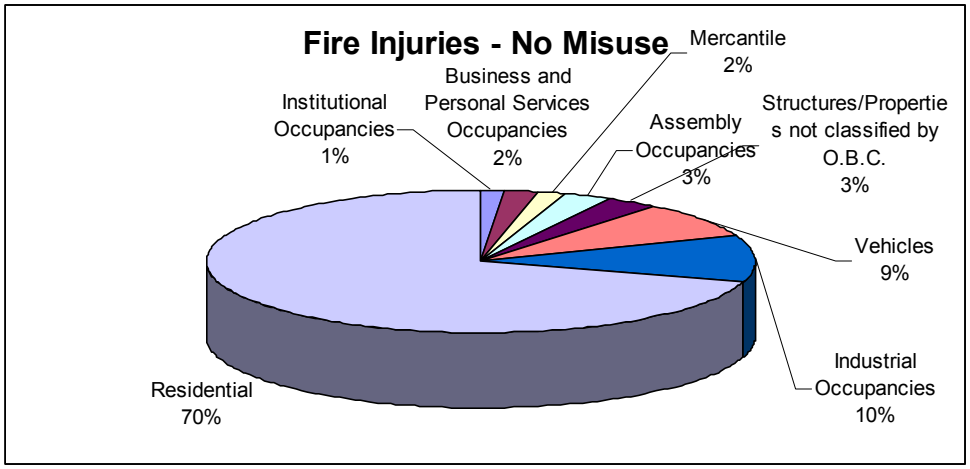


4.2.1. Fire Injuries – Electrical (no misuse)

To determine injuries as a result of true electrical mishaps or failure (as opposed to misuse), the data was further selected to include only causes such as electrical failure, defect in installation or construction and mechanical failure. The number of injuries for 1995 to 2003 as a result of electrical fires was further reduced to 560 injuries compared to 2106 total injuries.

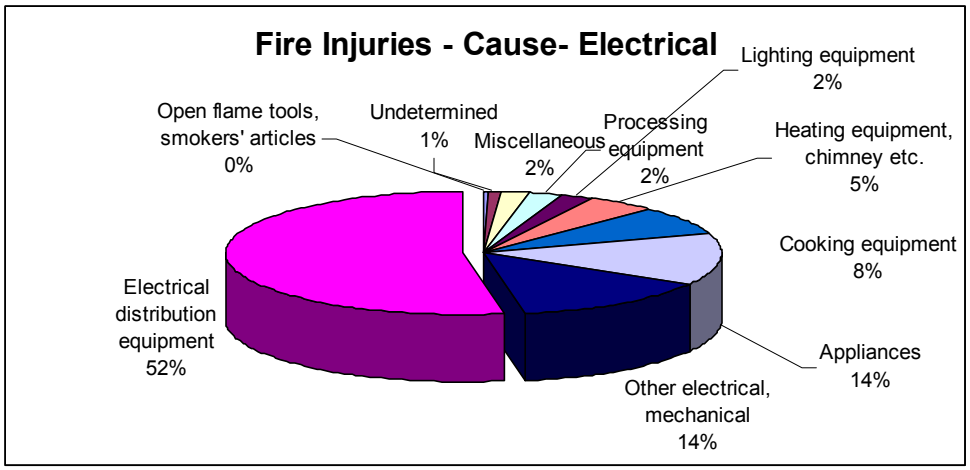
Residential facilities accounted for 70% of fire injuries of electrical nature with no misuse causes. Thus, regardless the cause of the fire, Figure 45 shows that residential facilities are still the prevalent facility for electrical injuries as a result of fire to occur.

Figure 45
Fire Injuries – Electrical, No Misuse Cause
1995-2003



For injuries as a result of non-misuse, the profile of ignition source for possible electrical failure shows electrical distribution system as the most prevalent ignition source (52%), followed by other electrical and mechanical equipment and appliances at 14% each (Figure 46). The distribution of injuries in Figure 46 is very different than Figure 40, where misuse are included. In Figure 46, cooking equipment only showed as the cause of 8% of these fires (compared to 56%).

Figure 46
Electrical Injuries Where Misuse is Not the Cause[60]
1995-2003



[60] Based on OFM records

When sorted by 'object first ignited', electrical wiring insulation showed most prevalent at 28%, followed by interior wall ceiling at 12%. Fire investigated by ESA seems to be verify OFM data.

5.0. Conclusion

2004 incident profile continues to show a decrease in fatality rate, going from 3.8 deaths per million population in 1971, to 0.64 deaths in 2004. Unfortunately, the actual number of fatality incidents has not changed that dramatically in the last seven years.

Prevalence of occupational electrocution continues. The ratio of occupational to non-occupational electrocution for 1998-2004 is approximately 2 to 1. This number will continue to rise as we see mostly occupational electrocutions in most recent years.

Increased prevalence of men in electrocution cases continues. No women were electrocuted in 2004. From 80 fatalities in 1998-2004, only 5 involved women (6%).

Deaths as a result of electrical fires remain small, below 3 incidents annually.

Despite only showing 2 powerline electrocutions in 2004, electrocution by powerline for 1998-2004 still accounted for 58% of all electrocutions compared to a prevalence of 60% from last year's report.

2004 saw another death of a farmer involving overhead powerline. Since 1998, all powerline deaths involving farmers has been in the Western region of Ontario, involving small non-dairy farmers.

Despite the absence of ladder fatalities of electrocution nature in 2004, ladder still represents a major number of electrical fatalities. Half of electrocutions in residential facilities involved ladders.

A quarter of the electrocutions between 1998-2004 involved workers in the electrical trade. There is at least one fatality annually involving these workers since 1998. The MOL noted that 25% of workplace electrocution involved workers knowingly working with energized equipment, and half of electrical injuries and fatalities in the workplace were the direct result of knowingly working with energized equipment.

Fire fatalities continue to decrease. They all occurred in dwellings, with detached single dwelling accounting for 50% of the incidents. Fire injuries have also decreased by 50% from 1995, but the ratio of injury to fire has not changed in that time period.

Serious injuries involving the use of multimeters and 347 Volt lighting continues.

6.0. Recommendations and Strategies

6.1. 2003 ESA's Electrical Safety Report.

As a result of ESA's 2003 Annual Safety Report, three action items were initiated:

a) *347 awareness campaign*

   ESA has launched a comprehensive campaign on the dangers of working with energized 347-Volt system to the electrical trades. Following the campaign 10% more respondents to a campaign impact assessment survey identified working on live 347 volt

systems as high-risk. ESA's effort to amend the Ontario Electrical Safety Code on 347 Volt requirements continues.

b) *Multimeter- Changing manufacturing standards for the protection of user from explosion caused by user error.*

ESA is now actively participating in the CAN/CSA-C22.2 – 1010 Standard, Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. ESA put forward two proposals to the 1010 Committee; one, requesting that the protection inside the device be placed to prevent the unit from exploding and two, some protective device be placed in leads of multimeters that would disallow energy to travel to the multimeter should the multimeter be used erroneously.

Similar to the 347 Volt system, ESA worked to increase awareness of safe multimeter practices in the electrical trades. An awareness impact assessment survey identified that 8% more trades workers would always remove multimeter leads prior to changing meter setting. In addition, all MOL inspectors were provided with information to increase their awareness of safe use practices and potential dangers of multimeters.

c) *Fire fatalities – explore with the OFM, manufacturers and standards development organizations opportunities to reduce fatalities initiated by cooking appliances.*

Through its participation on the Ontario Marshal's Public Safety Council, ESA has agreed to chair a council sub-committee that has been formed to address issues associated with stove-top fires. ESA is participating along with representatives from the OFM, CSA International, Underwriter Laboratories Canada and Electric Federation Canada to identify opportunities to improve the standard of stoves, increase public education and awareness,

explore the cost benefit of improving the safety of cooking technology.

d) Aerial Work Platform (AWP)

Due to other business commitments, ESA has not placed resources in this area to deal with AWP. There were no reported AWP incident with powerline in 2004.

6.2. ESA's future initiatives

347 Volt Safety Awareness

ESA is proposing a change to the Canadian Electrical Code Part I that would promote safety when using the 347 volt system. The proposed changes are:

"Where fluorescent luminaires or luminaires with ballasts are installed on branch circuits with voltages exceeding 150 volts-to-ground, a means of disconnecting each luminaire from the branch circuit shall be provided ".

And

"*Examples of disconnecting means that satisfy the intent of sub-rule (4) are pre-engineered wiring systems incorporating plug-type connectors, cord sets, and motor-base type luminaire connectors*[61]."

ESA is continuing to work to increase awareness about the hazards associated with working on live 347 volt systems among the electrical trade.

- ESA's 347 volt system safety campaign is being extended to new audience, including insurance companies, the MOL, and ESA clients. This campaign was showcased at the IAPA spring Health and Safety

[61] Should this change or a similar proposal not be adopted nationally, ESA will propose an Ontario specific requirement to address safety of 347-Volt lighting installation as part of the next Ontario Electrical Safety Code.

Conference in Toronto. Training initiative between the MOL and ESA have included awareness of the danger of working with 347 volts, and ESA is exploring opportunities to develop 347-volt system safety training with other industry stakeholders.

- Contractor Information Sessions – 347 volt system safety is a key component of Contractor Information Sessions that are being conducted throughout Ontario in 2005.

Multimeter

ESA has submitted a proposal to modified the CSA C22.2 Number 61010-1-04, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

"The following should be considered:

- *The fuse fault current rating shall be visible on the meter*
- *Create a new classification/group of meters where the consideration is made for fault current of the system being tested*

Section 16 of the 1010 Standard deals with current settings. Section 16.2 of the Standard covers multimeters, including a deviation where meters have to be tested for the maximum available fault current.

Items from past discussion:

Based on rule 2-034 of the OESC "no one shall use any electrical equipment other than approved electrical equipment of a kind or type and rating approved for the specific purpose for which it is to be employed" The CEC has the same requirement in 2-024

ESA believes that users are aware that the product (cat III for example) has been certified and tested for 50 amps at 600 which is the 30KVA. The fault current that is available in a Cat III area could be in the 25,000 Amp range. If a fault occurs the meter fails, the worker will likely be injured

The proposal in short should state that upon failure of a meter there should be no consequence to the meter and/or the system being tested.

In going ahead with some of the assumptions, ESA has requested from the 1010 standard committee, that testing be initiated on the meters to identify if a Multimeter can actually perform under these stringent requirements with an internal fuse, or will it be a requirement that all multimeters that are to be used in high fault levels, will need fused leads which are quick acting and able to interrupt high current? Why is it that most Utility workers use fused leads

with their multi-meter? Do they know something that the rest of the industry does not?

- Understanding the limitations of the standard and meters, ESA has advised all Field Evaluation agencies that as of June 15, 2005 multi-meters will not be permitted to be field evaluated (special inspection) in Ontario."

Home Depot Project - General Electrical Safety

In 2003, ESA initiated an electrical awareness campaign with 5 Home Depot stores across Ontario. The campaigned has worked to educated consumers on the risks associated with specific electrical installations and the safety steps that should be taken to protect themselves from potential hazards. The campaign includes a series of information posters that define risk and provide safety tips by specific installation, and includes an information kiosk that provides additional information on risk and access to more than 150 "Frequently Asked Questions" associated with safe electrical installations. The kiosk challenges store visitors to guess the risks involving in various electrical installations and encourage the general public to hire an electrical contractor for electrical project around homes. The positive response to this campaign has resulted in Home Depot approving the expansion of this campaign into 15 stores. This year, all Home Depot stores in Ontario display the risk posters. Interactive kiosks have been installed in the 15 Home Depot stores.

Powerline Safety

ESA has committed to develop and initiate communication of a powerline safety awareness campaign in FY 2006 (2005/2006). The EUSA PLMSC Group has designated a subcommittee to work on how the Utilities may effectively deal with powerline fatalities and injuries. ESA is exploring other possibilities.

ESA has reserved approximately $200,000 in the 2005/2006 fiscal year to support its powerline awareness campaign. The Electrical Safety Authority is interested in

inviting representatives from Local Distribution Companies to join a powerline safety communication working-group. With the recent introduction of the *Electrical Distribution Safety* Regulation the Electrical Safety Authority has committed to work with Local Distributors across Ontario to communicate critical electrical safety messages associated with distribution systems to the Ontario public, and to ensure that the Ontario public knows who to contact when they have specific questions and/or concerns associated with distribution systems where they live, work and play.

By introducing a working group of key communicators in the Distribution industry, the Electrical Safety Authority is focusing on ensuring that we can develop and introduce a campaign that will:

- minimize potentially hazardous situations through increased safety awareness
- ensure all members of the Ontario public, with a focus on high-risk areas, are at the receiving end
- increase continuity and consistency in powerline and other distribution safety messaging
- reduce redundancy in the development of communication and public awareness initiatives
- strengthen community good-will in the Utility industry, and

The working group will act as a safety alliance to ensure that any campaign material developed through the efforts of the Electrical Safety Authority will in fact meet the communication needs of the Local Distributors that operate in Ontario. Though ESA is initiating this action, the Local Distributors are seen as a key stakeholder and a critical distribution channel to reaching the Ontario public. By providing feedback on the scope and production of this campaign , the local distributors will participate in the development of a campaign that can by used by their company and other Local Distributors to support a province-wide safety efforts.

Ladder Safety

Through participation on the Elecsafe Alliance, ESA is initiating efforts towards ladder safety around powerlines. ESA is also a member of the CSA Z11.1 technical committee, The Safety Code for Portable Ladders. The Committee currently is reviewing the ladder standard and looking at methods of improving warnings on ladders concerning overhead powerline. It is also looking at alternative methods of increasing safety awareness when using ladders near overhead powerline.

Glossary

Accident – An undesired or unplanned event, resulting in property damage, injury or a fatality.

Aerial Work Platform (AWP) – a self-propelled work platform device, capable of lowering and lifting its work platform by mechanical means. It can be a scissor type, or articulating arm.

AFI – Application For Inspection, an application for performing electrical installation that requires inspection, as defined by the Ontario Electrical Safety Code.

CIHI – Canadian Institute of Health Information, a subsidiary of Health Canada, a not-for-profit organization responsible for collecting all health information across Canada.

Cost of Injury – Cost of injury as calculated by the WSIB in compensation, medical aid and pension.

CSAO – Construction Safety Association of Ontario, an accident prevention advisory organization, funded by the WSIB, serving the construction sector.

Electrician – A worker whose occupation is identified as working primarily with electricity.

Electrocution – an accidental death, caused by contact with electricity.

Fatality – an injury resulting in a death.

Human error- An inappropriate or undesired human decision or behaviour that reduces. or has the potential to reduce the safety or system performance.

LTI- Lost Time Injury, a term defined by the WSIB for an occupational injury that resulted in a worker missing more than one shift of work.

MOL – Ministry of Labour of Ontario.

Non-Occupational injuries – Injuries occurring in other than workplace.

NWIS – National Work Injury Statistics Program, an organization that serves as a repository of all occupational injuries in Canada.

Occupational Injury – an injury occurring in a workplace.

OFM – The Office of Fire Marshal, a provincial organization responsible for the prevention of fires in Ontario.

Powerline – Electrical cable or wire, used to transmit electrical energy, usually refers to overhead conductors.

RBD – Radial Boom Derrick – A self-propelled vehicle, equipped with a boom and an auger, capable of drilling a hole for utility pole, act as a lifting device when positioning the utility pole into place and also act as a work platform when a bucket-type platform is attached to the end of the boom.

Traumatic Injury – Injury as a result of a sudden or violent act

WSIB –Workplace Safety Insurance Board, an organization responsible for compensation of workplace injuries.

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