



**Electrical
Safety
Authority**

Electrical Safety Report

Ontario Powerline Incidents And High Risk Activities (2001 – 2007Q2)

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Utility Regulations Department

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Table of Contents

1.	Executive Summary	1
2.	Introduction	3
3.	Purpose.....	4
4.	Powerline Incidents in Ontario	5
5.	Incident Sources	7
5.1	Construction Sector	9
5.2	Public Sector	13
5.3	Farm Sector	17
5.4	Utility Sector	18
5.5	Transportation Sector	20
6.	The Fatalities	21
7.	Prioritizing the Incidents.....	22
7.1	DOE Electrical Severity Measurement Tool	22
7.2	ESA Electrical Risk Ranking Tool.....	25
8.	High Risk Activities & High At Risk Groups	27
8.1	Haulage – Waste & Material	27
8.2	Roof/Eavestrough & Exterior Home/Building Work	28
8.3	Aerial Lifting	28
8.4	Excavators/Landscapers	29
8.5	Tree Trimming/Cutting	29
8.6	Other High Risk Activities	30
9.	Root Causes & Other Analysis	31
9.1	Root Causes	31
9.2	Other Analysis.....	32
10.	Recommendations	35

1. Executive Summary

Incidents related to electrical powerlines in Ontario from 2001 to first half of 2007 represent more than 50% of total reported electrical occurrences (Electrical Safety Authority & Ministry of Labour).

Part of ESA's strategic plan for FY2008 is to develop a long term strategy to reduce powerline related fatalities by 30% (5 year rolling average) over a five (5) year period (2009-2013).

Prior to establishing new initiatives in the strategy it is important to examine existing data to identify the highest risk areas in order to focus initiatives over the next five (5) years.

There have been 1,431 powerline incidents between 2001 and the first half of 2007. The total reported fatalities from powerline incidents were 34; all except for 1 were incidents involving overhead powerlines.

The leading sectors for powerlines incidents:

- The construction sector with 1,140 incidents, of which 14 were fatalities;
- The public sector with 198 incidents, of which 12 were fatalities.

The activities which were identified as the most hazardous include:

- Overhead contact while loading/unloading during haulage of waste or material by dump trucks, cement trucks and garbage trucks.
- Overhead contact during roof, eavestrough or exterior work on homes or buildings.
- Overhead contact while aerial lifting using cranes, boom trucks and forklifts during construction or demolishing of buildings.
- Overhead contact while trimming, cutting or planting trees.
- Overhead/Underground contact from excavators, bulldozers, drilling rigs and portable augers during construction trenching, demolishing of buildings and landscaping.

The root cause or common thread in most of the electrical powerline incidents is that members of the public and workers, all too often have an insufficient

understanding of the hazards posed by electrical powerlines. Many of the investigations concluded that members of the public or workers didn't pay attention or didn't take the hazard posed by powerlines seriously, it's almost as if powerlines had been taken for granted.

To help reduce powerline fatalities, strategies need to be explored to change the technology surrounding design or equipment; improve or tighten up processes during or prior to construction; or change the behaviour of workers and the public when carrying out risky activities near overhead powerlines.

Specifically:

- Focused strategies for the construction sector, especially areas involving the following high risk activities or equipment:
 - Haulage Trucks Operators (Dump Trucks, Cement Trucks)
 - Roof Shingle/Tilers/ Eavestrough Installer
 - Crane & Boom Truck Operators
 - Tree Trimming/Cutting/Planting Contractors
 - Excavators & Landscapers (Backhoe Operators, Drilling Rig/Auger Operators)
- Focused strategies for the public sector with particular emphasis on:
 - DIY Householder
 - Education at the Primary School Levels

Based on the data presented in the report and the risk assessment, the strategies need to address scenarios such as:

- For the construction sector a male operator of high reach equipment such as dump trucks, boom trucks or cranes. He would work frequently in an urban setting in South Western Ontario where overhead powerlines are present near the work site.
- For the public sector a male do-it-yourselfer who performs roof work or tree trimming. He would reside in an older urban community in South Western Ontario where overhead powerlines are present near his home, since most newer subdivisions are underground.

2. Introduction

This report provides data on electrical powerline incidents that occurred in Ontario from 2001 to first half of 2007. Included in these statistics are electrical powerline incidents obtained from the Electrical Safety Authority (ESA) and the Ministry of Labour (MOL).

The electrical powerline incidents are presented in this report from a variety of perspectives:

- The incidents are sorted by the sectors in which they occur:
 - Construction
 - Public
 - Farm
 - Utility
 - Transport
- The incidents are also reported and sorted by the most hazardous activity or event.
- Ranking is applied to prioritize the “High Risk Activities” and also identify the “High at Risk Groups”.

3. Purpose

The purpose of this report is to document the first important component of ESA's long term strategy for powerline safety; the identification of "High Risk Activities" and "High at Risk Groups" involved in electrical powerline incidents.

Using statistics of electrical powerline incidents in Ontario from 2001 to first half 2007, priority will be assigned to the activities and groups with the highest demonstrated and/or perceived risk.

This information is intended to assist the Powerline Safety Strategy Working Group in identifying initiatives that will reduce powerline fatalities in the next five (5) years, with limited resources.

4. Powerline Incidents in Ontario

Incidents related to electrical powerlines in Ontario represent more than 50% of total reported electrical occurrences (Ministry of Labour & ESA). There have been 1,431 powerline incidents between 2001 and the first half of 2007, of which 34 resulted in fatalities.

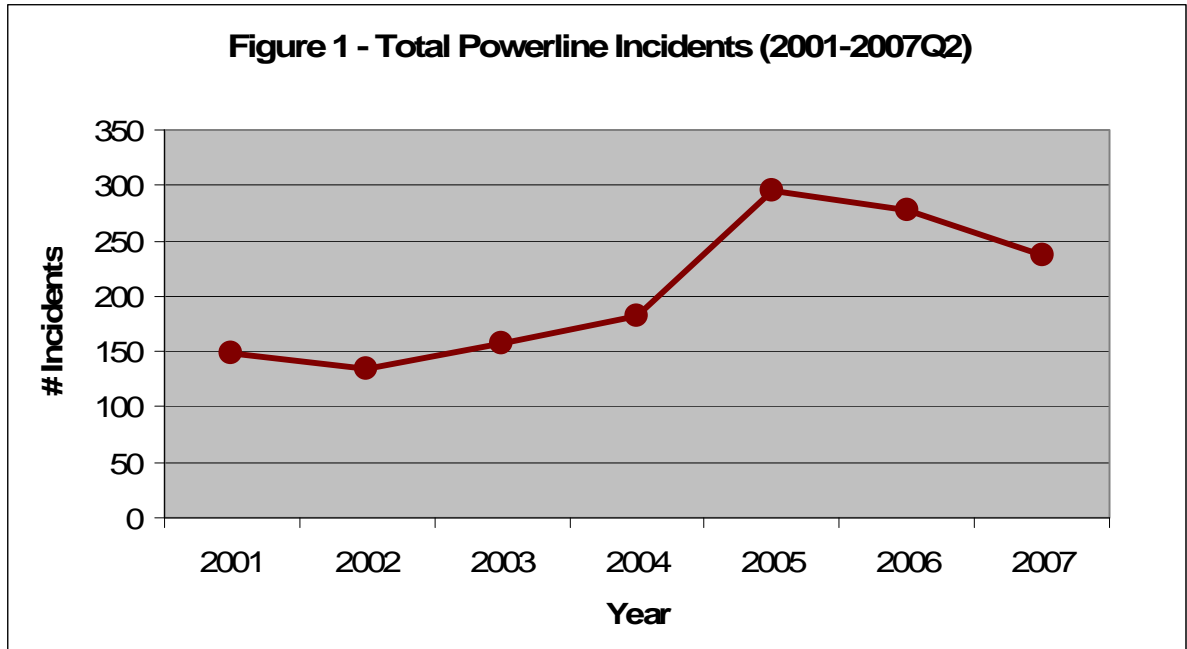
Ontario Electrical Powerline Incidents (2001-2007Q2)								
	2001	2002	2003	2004	2005	2006	2007Q2	Totals
Fatalities	10	3	6	2	6	5	2	34
Critical Injuries	8	5	9	7	10	17	12	68
Non-Critical Injuries	13	7	7	1	11	4	15	58
Property Damage	15	13	20	28	63	49	46	234
Near Misses	103	106	115	144	205	203	161	1,037
Totals	149	134	157	182*	295*	278*	236*	1,431

Table 1

Notes & Definitions:

1. Fatalities are a death as a direct or indirect result of making contact with powerlines.
2. Critical Injuries can include permanent disability, 2nd or 3rd degree burns, shock resulting in effects on the heart.
3. Non-Critical Injuries can include shock without any fibrillation or 1st degree burns.
4. Property Damage includes non-recoverable damage to assets such as machines, vehicles, homes, buildings or LDC owned assets.
5. Near Misses are incidents that resulted in no injury or property damage, but had the potential to cause damage, injury or death.
6. There were incidents that included both injuries and property damage, such incidents are only shown once in the table and are recorded as high up the chart as applicable.

* Ontario Regulation 22/04 came into effect (August 2004) whereby LDC's are required to report any Serious Incident.



The total incidents for the first half of 2007 were 236, at this rate the year 2007 will be a record year for incidents, easily surpassing the mark of 295 set back in 2005.

From the 1,431 reported powerline incidents, overhead powerline contact out numbers underground powerline contact by almost 2 to 1, however, more than 97% of the fatalities were due to overhead powerline contact.

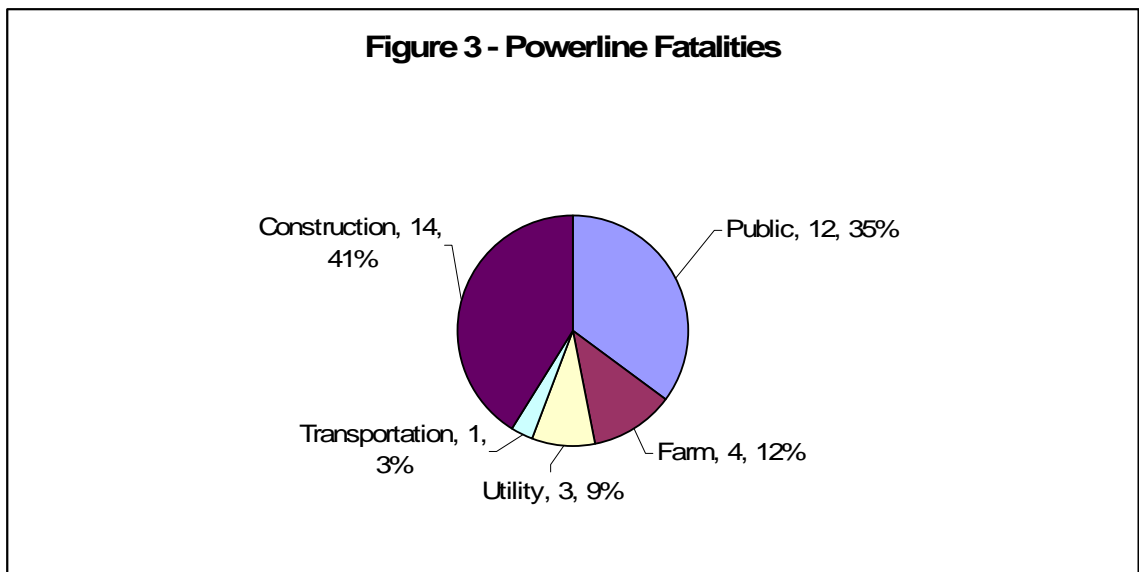
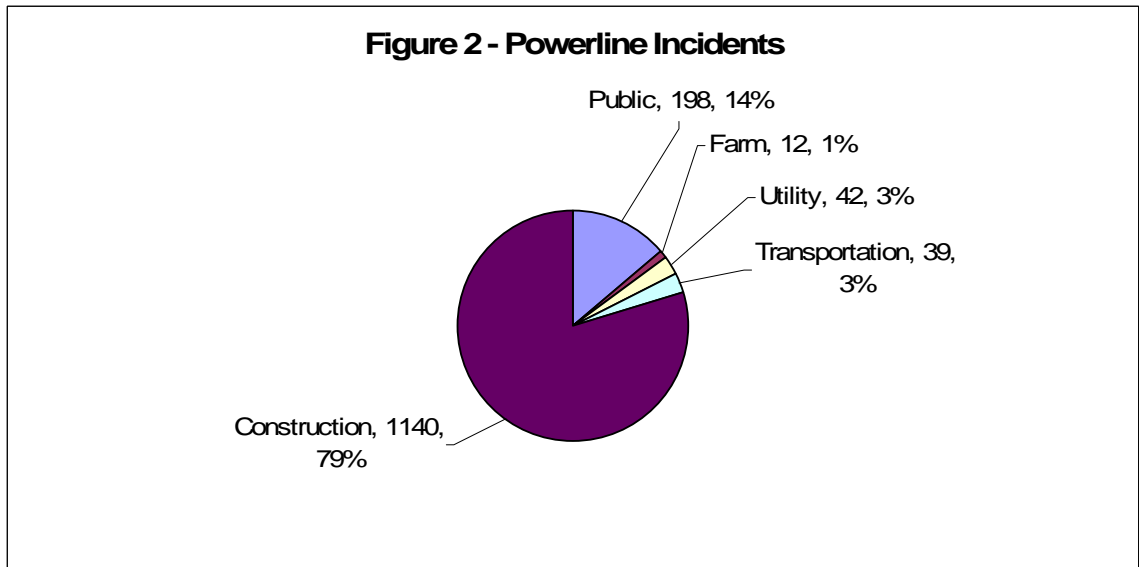
	Overhead Powerline Contact	Underground Powerline Contact
Fatalities	33	1
Critical Injuries	55	12
Non-Critical Injuries	43	15
Property Damage	196	38
Near Misses	602	436
Totals	929	502

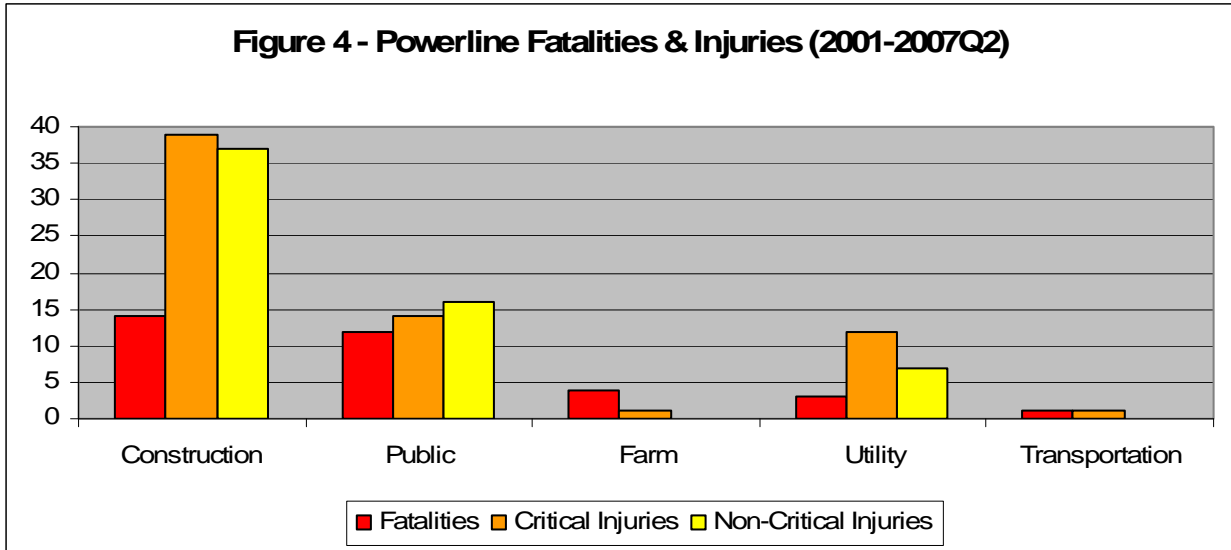
Table 2

5. Incident Sources

From 2001 to 2007Q2, the Construction sector accounted for 79% of all electrical Powerline related incidents (1,140 incidents including 14 fatalities).

Other sectors accounted for the following number and proportions: Public (198 incidents including 12 fatalities), Farm (12 incidents including 4 fatalities), Utility (42 incidents including 3 fatalities), Transportation (39 incidents including 1 fatality).





Ontario Electrical Powerline Incidents by Sector (2001-2007Q2)					
	<i>Construction</i>	<i>Public</i>	<i>Farm</i>	<i>Utility</i>	<i>Transportation</i>
<i>Fatalities</i>	14	12	4	3	1
<i>Critical Injuries</i>	39	14	1	12	1
<i>Non-Critical Injuries</i>	37	16	0	7	0
<i>Property Damage</i>	134	75	3	5	17
<i>Near Misses</i>	916	81	4	15	20
Totals	1,140	198	12	42	39

Table 3

5.1 Construction Sector

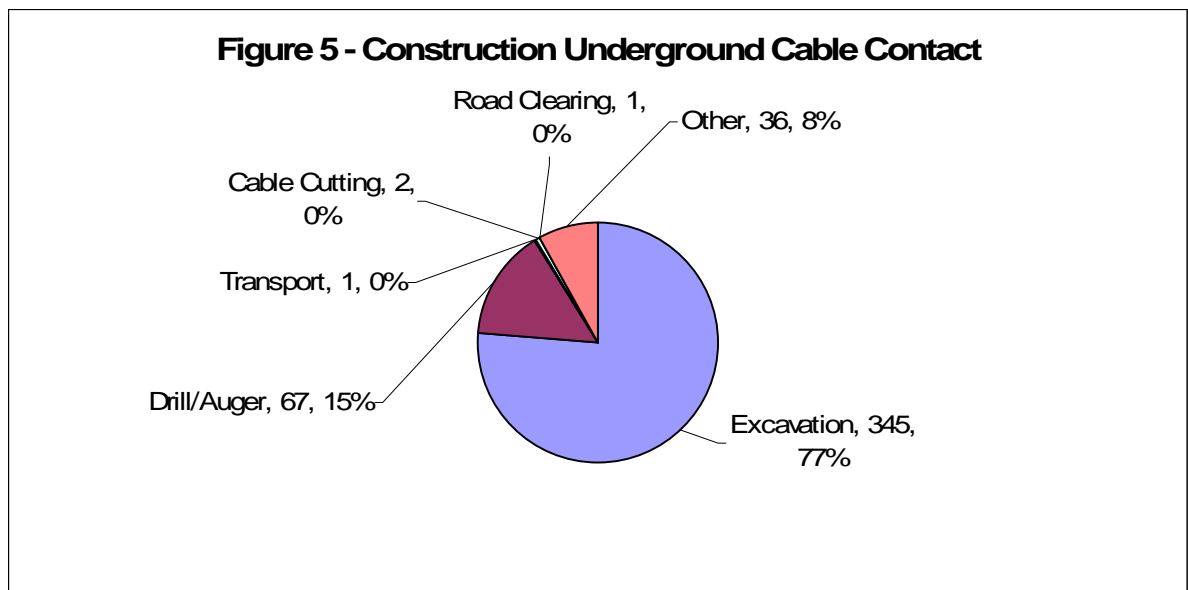
There have been 1,140 reported powerline incidents in the Construction sector since 2001. The ratio of overhead powerline incidents compared to underground powerline incidents has been more than 3 to 2. The number of powerline-related fatalities in the Construction sector has been 14; all have been overhead powerline contacts.

5.1.1 Underground – Construction Sector

The leading cause by far of construction-related underground powerline incidents involved excavation using backhoe/high-hoe, shovels and jackhammers.

Additional activities, equipment and operations in which underground powerline incidents have frequently occurred include:

- drill/auger using:
 - portable auger
 - directional bore machine
 - drilling rig
 - torpedo
- splicing live cables
- road clearing with snow removal equipment



Construction Underground Powerline Incidents (2001-2007Q2)						
Activity/Event	Equipment Involved/Contact Type	Consequence				
		Fatality	Critical Injury	Non-Critical Injury	Property Damage	Near Miss
Excavation	Backhoe/High-Hoe/Bulldozer/Vac Truck	0	0	3	13	270
	Shovel	0	2	2	1	35
	Jackhammer/Chipper/Saw	0	2	0	1	16
Drill/Auger	Portable Auger	0	1	2	0	27
	Directional Bore Machine	0	0	0	4	27
	Drilling Rig	0	2	0	0	3
	Torpedo	0	0	0	0	1
Transport	Barge	0	0	0	0	1
Cutting Cable	Tool	0	0	1	0	1
Road Clearing	Snow Removal Truck	0	0	0	1	0
Other	Details Not Available	0	0	0	0	36
Totals		0	7	8	20	417

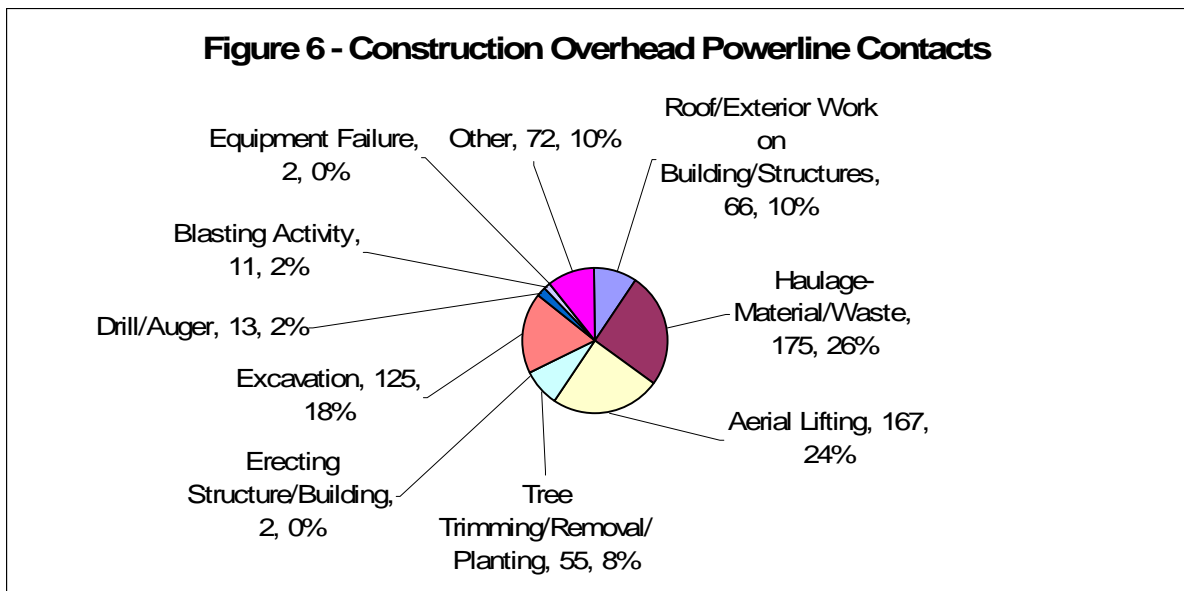
Table 4

5.1.2 Overhead – Construction Sector

The leading cause of overhead powerline incidents involved dump trucks, excavation equipment, cranes and boom trucks.

Additional high risk activities, equipment and operations in which overhead powerline incidents have frequently occurred include:

- roof/exterior work on building or structures using:
 - ladders
 - scaffolds/man lifts
 - eavestrough
 - extension poles
 - conveyors
 - high pressure water hoses
- cement/concrete pump trucks
- garbage trucks
- aerial lifting with forklifts and bucket trucks
- tree trimming/removal with chainsaws/trimmer, ladders & bucket trucks
- erecting/removing tent poles
- drill/auger with drilling rigs
- flying rock through blasting activities
- equipment failure involving insulators
- road clearing with snow removal equipment



Construction Overhead Powerline Incidents (2001-2007Q2)						
Activity/Event	Equipment Involved/Contact Type	Consequence				
		Fatality	Critical Injury	Non-Critical Injury	Property Damage	Near Miss
Roof/Exterior Work on Building/Structures	Ladder	2	8	6	0	8
	Body/Other Contact	2	5	3	1	5
	Scaffold/Man Lifts	1	2	0	3	11
	Eavestrough	1	0	1	0	2
	Extension Pole	0	0	0	1	2
	Conveyor	0	0	0	0	1
	High Pressure Water Hose	0	0	0	0	1
Haulage-Material/Waste	Dump Truck	4	2	1	35	109
	Cement/Concrete Pump Truck	0	2	4	3	10
	Garbage/Snow Trucks	0	0	0	1	4
Aerial Lifting	Crane	2	2	3	9	74
	Boom Truck	0	3	1	8	45
	Forklift	0	0	0	4	6
	Bucket Truck	0	1	0	1	6
	Other Trucks	0	0	0	0	2
Tree Trimming/Removal/Planting	Trimmer/Chainsaw	1	2	4	13	33
	Ladder	0	1	0	0	0
	Bucket Truck	0	1	0	0	0
Erecting Structure/Building	Tent Pole/Flag Pole/TV Antenna	1	1	0	0	0
Excavation/Auger-Drill	Back-Hoe/High-Hoe/Bulldozer/Vac-Truck	0	1	0	29	93
	Shovel	0	0	0	0	2
	Drilling Rig	0	0	1	0	12
Blasting Activity	Flying Rock	0	0	0	4	7
Equipment Failure	Insulators	0	1	0	0	1
Road Clearing	Snow Removal Truck	0	0	0	1	1
Other	No Details Given	0	0	5	2	65
Totals		14	32	29	114	499

Table 5

5.2 Public Sector

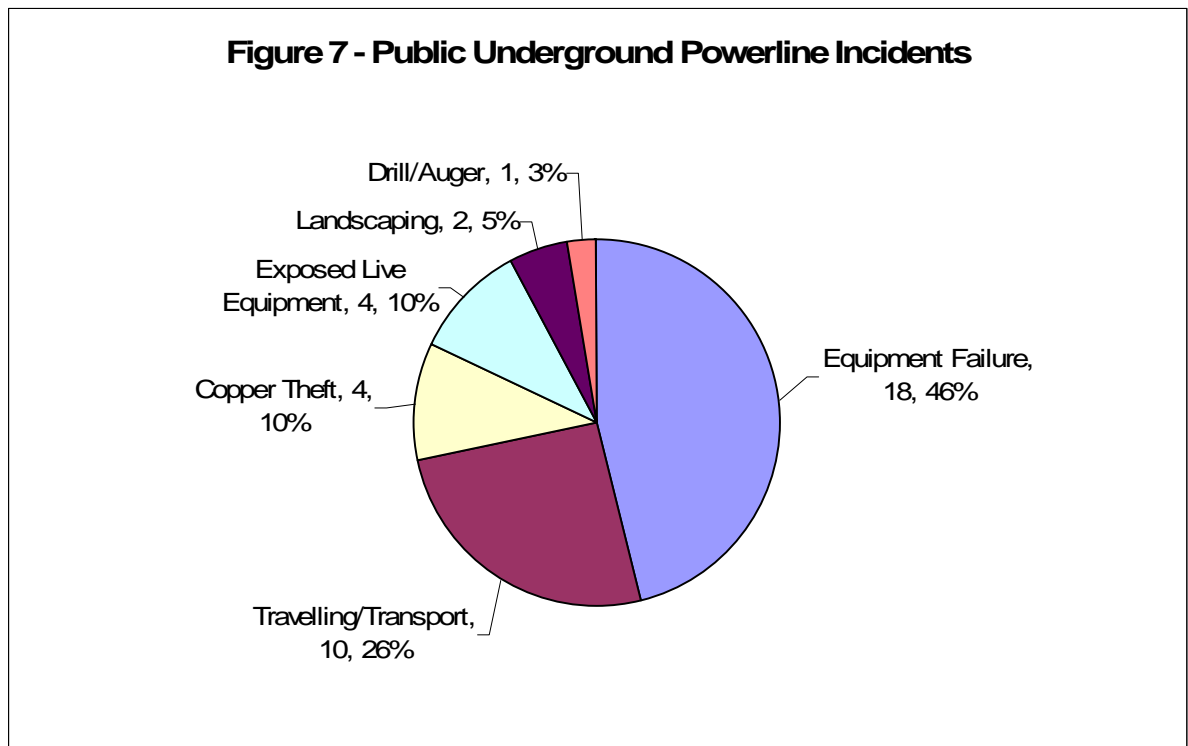
There have been 198 reported powerline incidents with the public since 2001. The ratio of overhead powerline incidents compared to underground powerline incidents has been almost 4 to 1. The number of powerline-related fatalities in the public sector has been 12; all have been overhead powerline contact.

5.2.1 Underground – Public Sector

The leading cause of underground powerline incidents was equipment failure and vehicle accidents with pad-mounted equipment.

Additional high risk activities, equipment and operations in which underground powerline incidents have frequently occurred include:

- copper theft from substations
- exposed live equipment
- landscaping with shovels
- use of a portable auger



Underground Powerline Incidents in Public Sector (2001-2007Q2)						
Activity/Event	Equipment Involved/Contact Type	Consequence				
		Fatality	Critical Injury	Non-Critical Injury	Property Damage	Near Miss
Equipment Failure	Splice/Cable/Arrestors	0	0	2	1	3
	Transformers/Switchgear	0	0	0	10	2
Travelling/Transport	Car/Van	0	0	0	7	3
Copper Theft	Substation	0	2	0	0	2
Exposed Live Equipment	Cables	0	0	0	0	4
Landscaping/Excavating	Shovel	0	0	0	0	2
Drill/Auger	Portable Auger	0	0	1	0	0
Totals		0	2	3	18	16

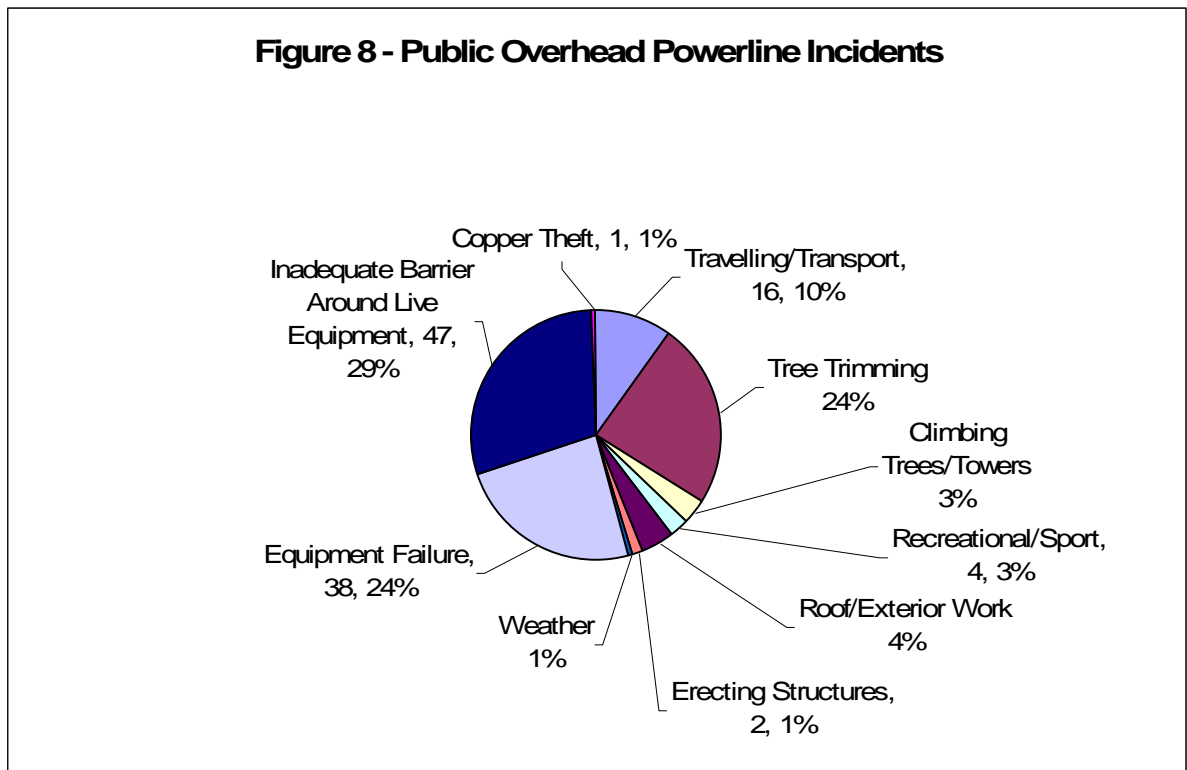
Table 6

5.2.2 Overhead – Public Sector

The leading cause of overhead powerline incidents was tree trimming, inadequate barriers around live conductors, equipment failure and vehicle accidents with hydro poles.

Additional high risk activities, equipment and operations in which overhead powerline incidents have frequently occurred include:

- Climbing hydro poles/towers
- Hand Gliding and Hot air ballooning
- Roof/Exterior building work with ladders
- Erecting flagpoles/TV Antennas
- Severe weather causing lines to fall
- Copper theft



Public Overhead Powerline Incidents (2001-2007Q2)						
Activity/Event	Equipment Involved/Contact Type	Consequence				
		Fatality	Critical Injury	Non-Critical Injury	Property Damage	Near Miss
Travelling/Transport	Car/Van	3*	0	0	10	0
	Trailer	0	0	0	0	2
	Boat	0	0	0	0	1
Tree Trimming/Cutting/Removal	Trimmer/Chain Saw	2	5	5	14	12
Climbing	Hydro Towers	2	0	3	0	0
Recreational/Sport	Hot Air Balloon/Hand Glider/Parachute/Kite Flying	2	0	0	0	2
Roof/Home Exterior Work	Ladders	1	4	0	1	1
Erecting Structures	Flagpoles/Antennas	1	0	0	1	0
Weather (High Winds)	Conductors Fell to Ground	1	0	0	0	0
Equipment Failure	Conductors/Insulators/Arrestors	0	2	2	7	12
	Hydro Poles	0	0	1	11	1
	Transformers	0	0	0	2	0
Inadequate Barriers Around Live Equipment	Conductors to Building/Structures	0	0	1	8	24
	Conductors to Trees/Vegetation	0	0	1	3	10
Copper Theft	Down-Spout	0	1	0	0	0
Totals		12	12	13	57	65

Table 9

Note: * The three (3) fatalities involving passenger vehicles were from no direct contact with powerlines, the deaths were a result of the impact from the vehicles colliding with hydro poles.

5.3 Farm Sector

There have been 12 reported powerline incidents in the farm sector since 2001. All the reported powerline incidents for farms have been overhead powerline contacts. The number of powerline-related fatalities in the farm sector has been 4; again all overhead powerline contact.

There was no leading cause of farming powerline incidents, however, the high risk activities, equipment and operations in which farming powerline incidents have occurred include:

- installing irrigation pipes
- use of portable auger
- vehicles such as spreading machine, tractors and front-end-loaders
- severe weather involving blowing hay
- crop spraying

Farm Overhead Powerline Incidents (2001-2007Q2)						
Activity/Event	Equipment Involved/Contact Type	Consequence				
		Fatality	Critical Injury	Non-Critical Injury	Property Damage	Near Miss
Drainage/Irrigation	Irrigation Pipes	2	0	0	0	0
Drill/Auger	Portable Auger	1	1	0	0	0
Plough/Spreading	Spreading Machine	1	0	0	0	0
	Tractor	0	0	0	1	0
Unloading/Loading	Front-End Loader	0	0	0	1	3
Weather	Hay	0	0	0	1	0
Crop Spraying	Airplane	0	0	0	0	1
Totals		4	1	0	3	4

Table 10

5.4 Utility Sector

There have been 42 reported powerline incidents in the Utility sector since 2001. The ratio of overhead powerline incidents compared to underground powerline incidents has been almost 3 to 1. The number of powerline-related fatalities in the Utility sector has been 3.

5.4.1 Underground – Utility Sector

The leading cause of underground powerline incidents was working with live cables.

Additional high risk activities, equipment and operations in which underground powerline incidents have frequently occurred include:

- installing/removing grounds
- excavation with a shovel
- use of a portable auger

Utility Underground Powerline Incidents (2001-2007Q2)						
Activity/Event	Equipment Involved/Contact Type	Consequence				
		Fatality	Critical Injury	Non-Critical Injury	Property Damage	Near Miss
Installing/Removing Grounds	Body Contact	1	0	0	0	0
Cable Work	Tools/Ladder	0	3	4	0	1
Excavation	Shovel	0	0	0	0	1
Drill/Auger	Portable Auger	0	0	0	0	1
Totals		1	3	4	0	3

Table 11

5.4.2 Overhead – Utility Sector

The leading cause of overhead powerline incidents was overhead work in a bucket truck and aerial lifting with either a boom truck or crane.

Additional high risk activities, equipment and operations in which overhead powerline incidents have frequently occurred include:

- equipment failure involving insulators and hydro poles
- installing/removing grounds
- severe weather involving insulating covers

Utility Overhead Powerline Incidents (2001-2007Q2)						
Activity/Event	Equipment Involved/Contact Type	Consequence				
		Fatality	Critical Injury	Non-Critical Injury	Property Damage	Near Miss
Overhead work in Bucket Truck	Ladder	1	0	0	0	0
	Body Contact	0	5	1	0	0
	Lost control of Conductors	0	0	0	0	3
	Bucket	0	0	0	1	1
	Tools	0	0	0	0	2
Aerial Lifting	Boom Truck	1	2	0	0	2
	Crane	0	0	1	1	4
Equipment Failure	Conductor/Insulator/Arrestor	0	1	0	0	0
	Hydro Pole	0	0	0	1	0
Installing/Removing Grounds	Body Contact	0	1	1	1	0
Weather (High Wind)	Insulating Covers	0	0	0	1	0
Totals		2	9	3	5	12

Table 12

5.5 Transportation Sector

There have been 39 reported powerline incidents in the transportation sector since 2001. All the reported powerline incidents for transportation have been overhead powerline contacts. The number of powerline-related fatalities in the transportation sector has been 1.

The leading cause of transportation powerline incidents involved trucks striking overhead conductors and hydro poles.

Transportation Overhead Powerline Incidents (2001-2007Q2)						
Activity/Event	Equipment Involved/Contact Type	Consequence				
		Fatality	Critical Injury	Non-Critical Injury	Property Damage	Near Miss
Delivery	Trucks contact overhead lines	1	1	0	12	18
	Trucks contact hydro poles	0	0	0	5	2
Totals		1	1	0	17	20

Table 13

6. The Fatalities

The most common types of equipment involved in powerline-related fatalities were dump trucks, tree trimmers, public vehicles, ladders and cranes.

Ontario Powerline Fatalities (2001-2007Q2)			
Sector	Activity	Equipment Involved/Contact Type	Fatalities
Construction	Roof/Exterior Work on Building/Structures	Ladder	2
		Body/Other Contact	2
		Scaffold/Man Lifts	1
		Eavestrough	1
	Haulage of Materials/Waste	Dump Trucks	4
	Aerial Lifting	Cranes	2
	Tree Trimming	Trimmer/Chainsaw	1
Erecting Structures	Tent Poles	1	
Public	Travelling/Transport	Car/Van	3
	Tree Trimming	Trimmer/Chainsaw	2
	Climbing	Hydro Poles/Towers	2
	Recreational/Sport	Hot Air Balloon/Hand Gliding	2
	Erecting Structures	Flag Pole	1
	Severe Weather	Conductors fell to ground	1
Farm	Drainage/Irrigation	Irrigation Pipes	2
	Drill/Auger	Portable Auger	1
	Plough/Spreading	Spreader Machine	1
Utility	Installing/Removing Grounds	Body Contact	1
	Overhead work in Bucket Truck	Ladder	1
	Aerial Lifting	Boom Truck	1
Transportation	Delivery	Standing on Truck	1

Table 14

7. Prioritizing the Incidents

To help identify and prioritize the high risk activities and groups, two (2) risk ranking tools were applied on the statistics:

- Electrical Severity Measurement Tool developed by the US Department of Energy (DOE/EFCOG Revision 1 dated April 16, 2007).
- Electrical Risk Ranking Tool developed by the Electrical Safety Authority (ESA Revision 1.0 dated December 20, 2007).

The application of the ranking tools are shown in section 7.1 and 7.2, both tools resulted in the identification the same high risk activities.

7.1 DOE Electrical Severity Measurement Tool

The tool is intended to determine the electrical severity of an electrical incident based on an evaluation of a series of electrical factors. The primary factors include:

- Electrical Hazard
- The Environment
- Shock Proximity
- Arc Flash Proximity
- Thermal Proximity
- Resulting Injury

Each electrical powerline incident is reviewed to determine its Electrical Severity (ES) using the following equation:

$$\text{Electrical Severity (ES)} = (\text{Electrical Hazard Factor}) * (1 + \text{Environment Factor} + \text{Shock Proximity Factor} + \text{Arc Flash Proximity Factor} + \text{Thermal Proximity Factor}) * (\text{Injury Factor})$$

Use of equation:

- **Electrical Hazard Factor:** (0,1,10,50,100) is determined by the level of electrical energy that was involved in the incident.
- **Environment Factor:** (0,5,10) is determined by the conditions of the surrounding (dry, damp, wet) involved in the incident.
- **Shock Proximity Factor:** (0,1,3,10) is determined by the rms voltage level of the exposed conductor or equipment and the distance from the exposed parts to people at the incident.
- **Arc Flash Proximity Factor:** (0,10) is determined based on the distance of the people involved to the energy source.
- **Thermal Proximity Factor:** (0,3,10) is determined by the power available by the energy source which came into contact with a conductive media.
- **Injury Factor:** (1=Near Miss, 3=Non-Critical Shock, 5=Arc Flash/Burn, 10=Shock effecting the Heart, 20=Permanent Disability/3rd Degree Burn, 100=Fatality)

Note: If proper PPE/Equipment was utilized to protect the person from the electrical hazard it would reduce the associated factor to 0 (applies to shock proximity, arc flash proximity and thermal proximity factors).

Prioritized High Risk Activities with DOE Tool Applied				
Activity	Equipment Involved/Contact Type	Sectors Involved	Score (000's)	% of Total
Roof/Eavestrough/Exterior Work on Buildings/Structures	Ladders, Scaffolds, Man Lifts, Extension Poles, Conveyors	Public & Construction	2,109	23.8%
Tree Trimming/Cutting	Trimmers, Chainsaw, Ladders, Bucket Trucks	Public & Construction	1,453	16.4%
Haulage – Materials/Waste	Dump Trucks, Cement Trucks, Garbage Trucks	Construction	1,202	13.5%
Aerial Lifting	Cranes, Boom Trucks, Forklifts	Construction	1,103	12.4%
Excavating/Landscaping	Backhoes, Bulldozers, Vac Truck, Shovels, Bore or Auger	Public & Construction	783	8.8%
Vandals & Thrill Seekers	Copper Theft, Trees, Poles Towers, Substations	Public	740	8.3%
Erecting/Removing Structures	Ladders, Bucket Truck, Tent Poles, Flag Poles, TV Antennas	Public & Construction	460	5.2%
Drainage/Irrigation	Irrigation Pipes	Farm	320	3.6%
Transportation	Passenger Vehicles, Tractor Trailers, Boats	Public & Transport	302	3.4%
Equipment Failure	Poles, Insulators, Arrestors, Conductors, Transformers	Public & Utility	153	1.7%
Plough/Spreading	Tractors	Farm	83	0.9%
Inadequate Barrier around Live Equipment	Conductor barrier to trees and buildings	Public	69	0.8%
Overhead Work in Bucket Truck & Splicing Cable	Tools, Conductors	Utility	51	0.6%
Weather Related	Conductors, Poles, Hay	Public, Utility & Farm	21	0.2%
Others	Flying Rock, Snow Clearing	Construction	16	0.2%
Leisure & Sport	Hot Air Balloon, Hand Glider, Parachute, Kites	Public	12	0.1%

Table 15

7.2 ESA Electrical Risk Ranking Tool

The tool is intended to determine the risk of an electrical incident based on Traditional Risk = Probability x Impact, where:

Use of equation:

Probability (sum of):

- **Probability of Exposure:** (1,2,5,8,10,20) is determined by frequency of exposure and whether it is public or worker exposure.
- **Frequency of Exposure:** (1,2,5,10) is determined by what frequency the incidents have been occurring.

Impact (sum of):

- **Injury Type:** (1=Near Miss, 2=Injury, 8=Critical Injury, 10=Fatality).
- **Quantity:** (1= one hurt, 2 = two hurt, 5 = three to four hurt, 10 = five or more hurt).
- **Who was Hurt:** (1= trained worker, 2 = non-trained worker, 3 = member of the public).
- **Potential of Harm:** (1=isolated accident, 2=occurs once every 3 years, 5=occurs once every 2 years, 10=occurs annually).

Prioritized High Risk Activities with ESA Tool Applied				
Activity	Equipment Involved/Contact Type	Sectors Involved	Score (000's)	% of Total
Haulage – Materials/Waste	Dump Trucks, Cement Trucks, Garbage Trucks, Snow Trucks	Construction	271	25.5%
Aerial Lifting	Cranes, Boom Trucks, Forklifts	Construction	249	23.5%
Excavating/Landscaping	Backhoes, Bore Machines, Augers, Bulldozers, Vac Truck, Shovels	Public & Construction	200	18.8%
Roof/Eavestrough/Exterior Work on Buildings/Structures	Ladders, Scaffolds, Man Lifts, Extension Poles, Conveyors	Public & Construction	146	13.8%
Tree Trimming/Cutting	Trimmers, Chainsaw, Ladders, Bucket Trucks	Public & Construction	97	9.1%
Transportation	Passenger Vehicles, Tractor Trailers, Boats	Public & Transport	58	5.5%
Erecting/Removing/Maintaining Signs & Structures	Ladders, Bucket Truck, Tent Poles, Flag Poles, TV Antennas	Public & Construction	21	2.0%
Vandals & Thrill Seekers	Copper Theft, Trees, Poles Towers, Substations	Public	5	0.5%
Equipment Failure	Poles, Insulators, Arrestors, Conductors, Transformers	Public & Utility	4	0.4%
Others	Blasting Activities	Construction	4	0.3%
Overhead Work in Bucket Truck & Splicing Cable	Tools, Conductors	Utility	3	0.2%
Inadequate Barrier around Live Equipment	Conductor barrier to trees and buildings	Public	2	0.2%
Plough/Spreading	Tractors	Farm	1	0.1%
Leisure & Sport	Hot Air Balloon, Hand Glider, Parachute, Kites	Public	1	0.1%
Drainage/Irrigation	Irrigation Pipes	Farm	0.4	0.0%
Weather Related	Conductors, Poles, Hay	Public, Utility & Farm	0	0.0%

Table 16

8. High Risk Activities & High At Risk Groups

The following five (5) groups of activities represent almost 83% of the overall hazardous powerline incidents.

Prioritized High Risk Activities - Based on Average of DOE & ESA Models					
<i>Activity</i>	<i>Equipment Involved/Contact Type</i>	<i>Sectors Involved</i>	<i>DOE Score (%)</i>	<i>ESA Score (%)</i>	<i>Total Average (%)</i>
Haulage – Materials/Waste	Dump Trucks, Cement Trucks, Garbage Trucks, Snow Trucks	Construction	13.5%	25.5%	19.5%
Roof/Eavestrough/Exterior Work on Buildings/Structures	Ladders, Scaffolds, Man Lifts, Extension Poles, Conveyors	Public & Construction	23.8%	13.8%	18.8%
Aerial Lifting	Cranes, Boom Trucks, Forklifts	Construction	12.4%	23.5%	18.0%
Excavating/Landscaping	Backhoes, Bulldozers, Vac Truck, Shovels	Public & Construction	8.8%	18.8%	13.8%
Tree Trimming/Cutting	Trimmers, Chainsaw, Ladders, Bucket Trucks	Public & Construction	16.4%	9.1%	12.8%

Table 17

8.1 Haulage – Waste & Material

High Risk Activities

- Raising truck box to load/unload
- Moving Cement truck chutes/pump hose

At Risk Groups

- Dump Truck Operators
- Cement/Concrete Pump Truck Operators
- Garbage Truck Operators
- Other contractors/employees in vicinity

8.2 Roof/Eavestrough & Exterior Home/Building Work

High Risk Activities

- Painting of building/home fascias
- Eavestrough/Down-Spout installation or removal
- Re-shingling of roof

At Risk Groups

- Roof Fixers
- Roof Shingle/Tilers
- Eavestrough Installers
- Painters
- DIY Householders

8.3 Aerial Lifting

High Risk Activities

- Delivering and off-loading construction material & equipment
- Demolishing of Buildings/Structures
- Erecting and construction of large buildings

At Risk Groups

- Crane operators
- Boom Trucks
- Forklifts
- Other contractors/employees in vicinity

8.4 Excavators/Landscapers

High Risk Activities

- Trench work for utility installations
- Demolishing of Buildings/Structures
- Soil drilling
- Fence post installation

At Risk Groups

- Backhoe Operators
- Bulldozers Operators
- Drilling Rigs Operators
- Portable Augers Operators
- Other contractors/employees in vicinity
- DIY Householders

8.5 Tree Trimming/Cutting

High Risk Activities

- Tree Trimming
- Tree Cutting
- Removing Stumps
- Planting Trees

At Risk Groups

- Tree Trimming/Cutting Contractors
- DIY Householders
- Tree Planting Contractors
- Emergency service personnel effecting rescue
- Emergency service personnel effecting restoration of services

8.6 Other High Risk Activities

Other High Risk activities worth noting include:

- Transportation: the “at risk” groups are large transport trucks, delivery vehicles and passenger vehicles.
- Vandalism & Thrill Seekers: such as theft of copper, climbing towers or poles, unauthorized entry of substations, and tampering with equipment. The “at risk” groups would include children, teens, adults and vandals.
- Erecting or Removing Structures: such as large tents, flag poles, tv/satellite antennas, installing cable on poles or buildings. The “at risk” groups would be TV/Sat Antenna Installers, Communication network installers and the DIY Householders.

9. Root Causes & Other Analysis

9.1 Root Causes

The root cause or common thread in most of the electrical powerline incidents is that members of the public and construction workers, all too often have an insufficient understanding of the hazards posed by electrical powerlines. Many of the investigations concluded that members of the public or construction workers just didn't pay attention or didn't take the hazard posed by powerlines seriously, it's almost as if powerlines had been taken for granted.

Powerline incidents involving construction type activities typically involved non-electrical workers (equipment operators or laborers), performing non-electrical work, who may not have any type of electrical safety training or expectation that an electrical hazard exists.

In many occurrences, workers assumed that the powerlines were de-energized or abandoned, or they assumed the wrong proximity of overhead conductors or the wrong depth or direction of the buried cables.

In cases where spotters were used, they either lost communications with the drivers or a single spotter was insufficient to see all the hazards.

Some comments from people who were involved in powerline incidents included:

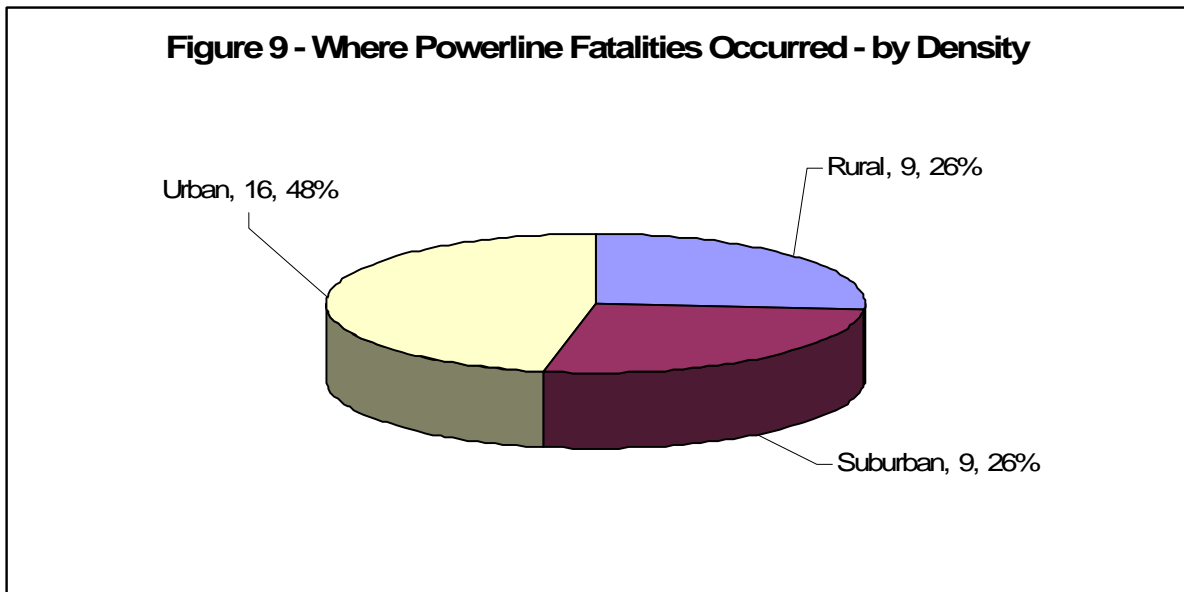
- "I didn't think those thin powerlines had enough power to hurt me"
- "I thought powerlines were all insulated"
- "If I don't get this load dumped, I don't get paid"
- "I had guessed incorrectly on the clearance between my truck and the overhead lines".
- "I lost communication with my spotter".
- "I thought you have to have direct contact with the powerline in order to sustain injury"
- "I was not trained for High Voltage"
- "I can't afford to hire someone to trim my trees".

9.2 Other Analysis

The data thus far has been analyzed to identify the sector, activities and groups involved in powerline incidents.

Other basic facts for the fatalities reported between 2001 and 2007Q2 involve:

- 1) Almost half the fatalities occurred in an urban municipality.
- 2) The majority of the powerline fatalities occurred in South Western Ontario.
- 3) All of the powerline fatalities involved males.
- 4) There was only one powerline fatality involving underground systems.
- 5) The majority of the powerline fatalities involved high-voltage primary lines.



Notes & Definitions:

- 1) Urban municipalities are areas where the population density is greater than 500 people/square km.
- 2) Suburban municipalities are areas where the population density is 100-500 people/square km.
- 3) Rural municipalities are areas where the population density is less than 100 people /square km.

Figure 10 - Where Powerline Fatalities Occurred - By Area

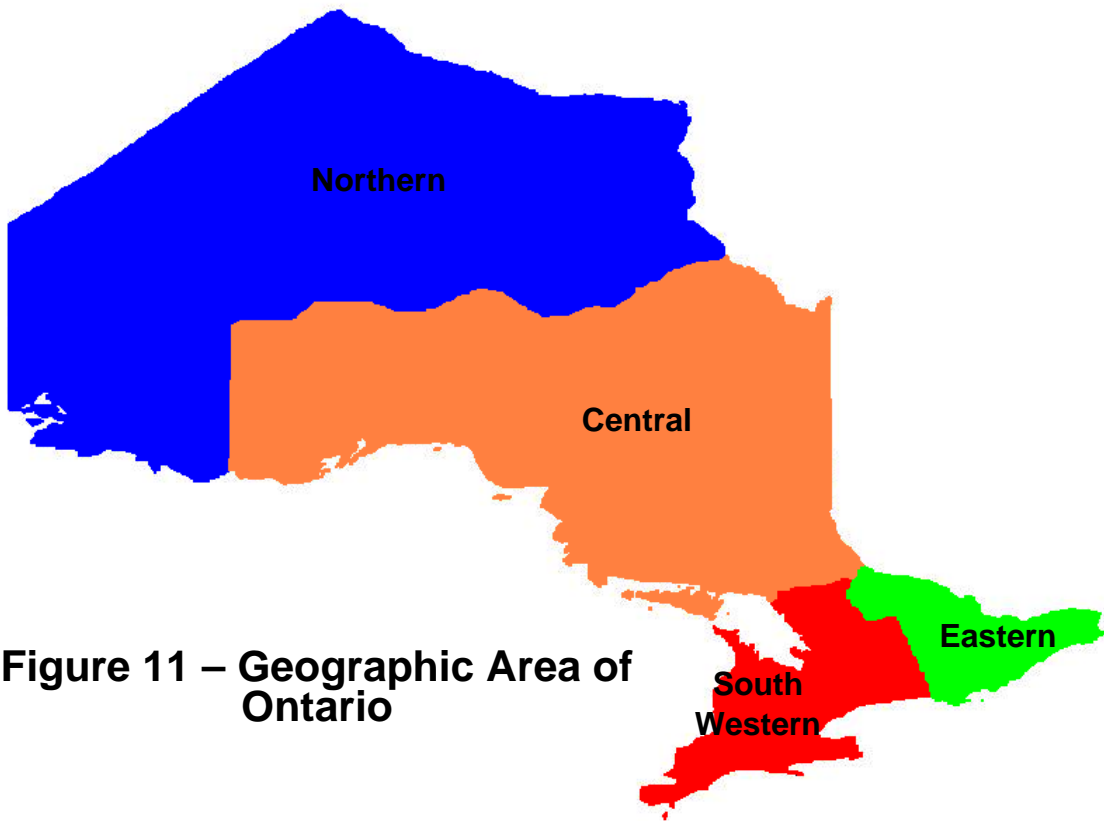
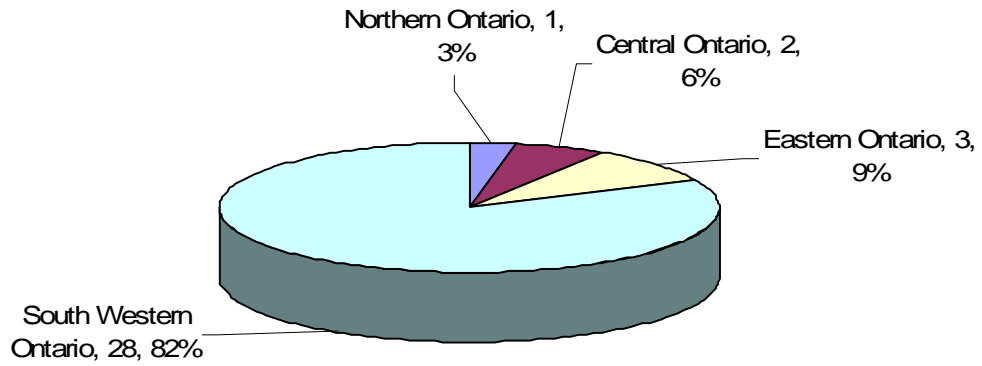
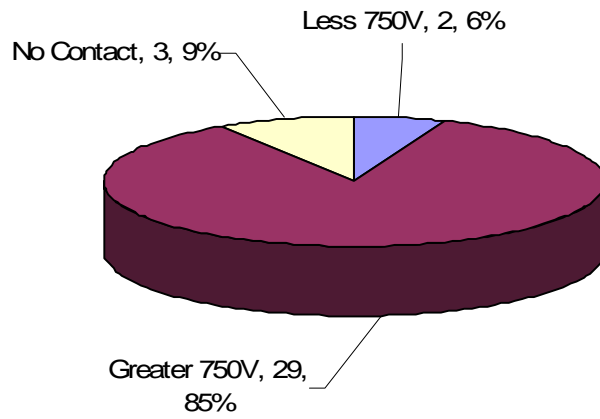


Figure 11 – Geographic Area of Ontario

Figure 12 - Where Powerline Fatalities Occurred - By Voltage



10. Recommendations

The leading sectors for powerlines incidents are clearly the Construction sector with 1,140 incidents, of which 14 were fatalities and the Public sector with 198 incidents, of which 12 were fatalities.

To help reduce powerline fatalities, strategies need to be explored to change the technology surrounding design or equipment; improve or tighten up processes during or prior to construction; or change the behaviour of workers and the public when carrying out risky activities near overhead powerlines.

Specifically:

- Focused strategies for the construction sector, especially areas involving the following high risk activities or equipment:
 - Haulage Trucks Operators (Dump Trucks, Cement Trucks)
 - Roof Shingle/Tilers/ Eavestrough Installer
 - Crane & Boom Truck Operators
 - Tree Trimming/Cutting/Planting Contractors
 - Excavators & Landscapers (Backhoe Operators, Drilling Rig/Auger Operators)
- Focused strategies for the public sector with particular emphasis on:
 - DIY Householder
 - Education at the Primary School Levels

Based on the data presented in the report and the risk assessment, the strategies need to address scenarios such as:

- For the construction sector a male operator of high reach equipment such as dump trucks, boom trucks or cranes. He would work frequently in an urban setting in South Western Ontario where overhead powerlines are present near the work site.
- For the public sector a male do-it-yourselfer who performs roof work or tree trimming. He would reside in an older urban community in South Western Ontario where overhead powerlines are present near his home, since most newer subdivisions are underground.