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Internal Report (National Research Council of Canada. Institute for Research in Construction), 1992-02

National Research Council Canada
Conseil national de recherches Canada

Institute for Research in Construction
Institut de recherche en construction

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Ontario Fire Loss Statistics for the Risk-Cost Assessment Model

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Internal Report No. 622

Date of issue: February 1992

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Canada

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by

S. Mailvaganam, D. Yung and M. Prencipe*

ABSTRACT

Fire loss statistics at the Ontario Fire Marshal's Office in Toronto were retrieved to find relevant data for the risk-cost assessment model which is being developed at the National Fire Laboratory. The risk-cost assessment model is a computer model that can be used to assess the cost effectiveness of fire safety provisions in highrise buildings. Statistical data needed include the probabilities of fire starts; the types of fires; the effectiveness of alarm and sprinkler systems in saving lives; and the response and set-up time of fire departments. The determination of set-up time was carried out in a separate study through collaboration with Ontario fire departments. The present report documents and discusses the findings of these two studies.

*Office of the Fire Marshal of Ontario, Toronto

TABLE OF CONTENTS

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INTRODUCTION

Over the past few years, the National Fire Laboratory of the National Research Council of Canada has been developing risk-cost assessment models that can be used to evaluate the cost effectiveness of fire safety provisions in highrise buildings. These models use both mathematical models based on physical laws, and probabilistic models based on statistical data, to determine the fire risks and protection costs in highrise buildings.

The purpose of this study was to obtain Ontario fire loss statistics on apartment and office building fires for the development of the risk-cost assessment models. Four major areas of statistics were needed:

i) Fire Incidence: to predict the probabilities of fire starts.
ii) Fire Types: to predict the probabilities of occurrence of three types of fires (smouldering, non-flashover and flashover).
iii) Fire Protection: to predict the effectiveness of alarm and sprinkler systems in saving lives.
iv) Fire Service: to predict the response and set-up times of fire departments.

The study focused on fire loss statistics for the province of Ontario where these statistics are gathered and processed at the Office of the Fire Marshal (OFM). It is from the OFM that fire reporting documents are circulated to fire departments across Ontario (samples of the fire reporting documents are shown in Appendix A). Statistical data obtained are then entered into a database called the Fire Loss Reporting System (FLRS). Unlike the National Fire Incident Reporting System (NFIRS) in the U.S., which captures roughly one-third of U.S. fires each year and extrapolates the rest, the FLRS documents all fires that occur in Ontario. The current FLRS database spans from 1983 to the present and publications regarding fire losses are issued annually by the OFM based on this data.

As well as the FLRS, the OFM maintains a second database, called the Fire Safety Report (FSR) database. This database contains detailed information on some fires which were investigated by the OFM during the years 1984 to 1987. The fires investigated were of a significant nature and include fatal fires, large loss fires, suspected incendiary fires and explosions. A sample of the form used by the fire investigators is also shown in Appendix A.

All four groups of fire statistics, excluding data on fire department set-up time, were obtained from both the FLRS and the FSR databases. Set-up time is not recorded on either database and was obtained separately through the fire departments. Other supplementary statistics, such as office space and number of apartment units, were obtained from outside sources.

METHODOLOGY

The nature and validity of the statistics compiled in this report are a product of the database set-ups, its strengths and weaknesses, and the discrepancies that exist between each database.

The Fire Loss Reporting System (FLRS) is a mainframe database located at the Queen's Park central processing area. It contains information on all reported fires in the province of Ontario as collected by district fire departments. Retrieval of statistics on this system can be tedious and time consuming as every submission for retrieval must be sent to Queen's Park before being processed. Currently, this antiquated system is being phased out and a network file-server system is being implemented at the OFM. It should be noted that the 1987 FLRS files were lost and partially reconstructed. At the time of retrieval, it was not known to what degree the files were restored.

The Fire Safety Report (FSR) database is a PC-based system that is run by the program DbaseIV. The fires contained in the FSR are a small subset of those in the FLRS, and are those that have been investigated by the OFM during the years 1984 to 1987. The FSR fires include fatal fires, large loss fires, suspected incendiary fires and explosions. Because of the nature of the fires, the FSR database is highly biased towards more significant fires. However, information in the FSR database was provided by trained investigators from the OFM. Therefore, the FSR database has more detailed information and is considered to be more accurate than the FLRS.

Few discrepancies exist between the FLRS and FSR databases, except in the area of alarm systems. The Standard Fire Report, which is the basis for the FLRS, is ambiguous, especially with respect to alarms. As a result of this ambiguity, a large number of inconsistencies in the reporting may have resulted.

From the FLRS database, statistics on fire incidence, property loss, alarm and sprinkler systems, injuries, deaths, and response time can be obtained. From the FSR database, all of the aforementioned (except response time) information, including the extent of fire spread, is obtainable.

Since data in the FSR database is limited to the time period from 1984 to 1987, any data extracted from the FLRS database ideally should also be from the same four years to facilitate comparison. It was not possible to do this as the sample size of four years was not large enough to see definite trends or established patterns. It was decided that, where possible, the tables based on the FLRS would be compiled for the maximum period available, from 1983 to 1990, to increase the size of the data set. However, to allow for proper comparison with the FSR data, tables based on the FLRS were also compiled for the shorter time period, from 1984 to 1987. It should be noted that the one table that could not be derived from the FLRS database was the Extent of Fire Spread table, as this information pertained strictly to the FSR database.

Most of the information in both databases is codified based on a set of standard codes. These codes characterize such things as area of fire origin, source of ignition, material first ignited and property classification. As this study deals strictly with apartment and office buildings, the codes most closely characterizing these types of structures were used. For apartment buildings, the codes for Multi-Unit Dwellings (two or greater, Property Classifications 131-133) were used; and for office buildings, the Property Classification for General Office Buildings (531) was used. The Multi-Unit Dwelling categories do not include any rooming, boarding and lodging houses or attached dwellings such as rowhouses or townhouses.

To allow for the analysis of the effect of sprinkler systems, statistics were retrieved separately for both sprinklered and non-sprinklered buildings.

In some tables, the category "unknown" will appear. Occurrences in this category indicate that information was not available but the incident has been included in the total to give an indication of the number of fires in a given breakdown.

Supplemental data, such as number of apartment units and available office space, were required to construct some of the tables. Reference was made to Statistics Canada tables to determine the number of apartment units in Ontario. Unfortunately, statistics in the tables only listed apartment buildings five storeys or greater which was not consistent with the building types being surveyed in the fire loss databanks. Through the Ontario Ministry of Treasury and Economics, it was possible to obtain pertinent data on the number of apartment units in Ontario from the 1986 census data (see Appendix B).

The search for comprehensive data on total office space in Ontario was not as successful. Many private agencies, such as Canadata, had summary statistics on construction starts on an annual basis but none had cumulative data. The only information that could be found was a survey by Royal LePage in 1989 on Canadian real estate in major urban centres (The Royal LePage Market Survey, Canadian Real Estate, 1989). For Ontario, this report lists office space only for the Toronto and Ottawa/Carleton areas.

Another roadblock was encountered when trying to locate statistics on the number of people living in units that had sprinkler systems, no sprinklers, alarms, or no alarms and combinations thereof. These statistics, to be used in the evaluation of fire protection systems, were still unavailable at the time of writing.

One area of study dealt with fire department set-up time. This issue was addressed in a separate study as set-up time was not recorded in either database. The methodology that was used will be addressed in the Fire Services section of this report.

FIRE INCIDENCE

Due to insufficient data on apartment units and office space, Table 1 on rate of fire incidence could not be assembled to completion. For apartment buildings, only 1986 figures on apartment units were available (Appendix B) and therefore only 1986 fires were tabulated. The number 2.16E-03 represents the rate of fire starts per apartment unit. For office buildings, only 1989 figures on office space were available, as mentioned previously, and hence only 1989 fires were tabulated. Moreover, only office space for the Metropolitan Toronto and Ottawa areas were available and therefore only fires for those two cities were tabulated. The number 7.68E-6 represents an estimate of the number of fire starts per square metre of office space.

Table 1

Fire Incidence for Apartment and Office Buildings in Ontario

Year	Building	No. of Fires	Quantity	Rate**
1986	Apartment	2,300	881,675 units	2.61E-03
1989*	Office	110	14,325,600 sq. m	7.68E-06

* Office statistics apply only to the Regions of Metropolitan Toronto and Ottawa-Carleton.
** Rate is the no. of fires per apartment unit or per sq. m office space.

FIRE TYPE

a) Apartment Buildings

i) Property Loss (Tables 2-7)

In these tables, fire death rates are shown in $1,000 property loss intervals. Any significant changes in death rate can be regarded as indicators of changes in fire type. For buildings without sprinklers, the FLRS tables (2 and 4) show a general increase in death rate with property loss; whereas the FSR table (6) shows, as expected, no definite trend in death rate due to the smaller size of the database and the skewed nature of the data sample. For buildings with sprinklers, both the FLRS tables (3 and 5) and the FSR table (7) show no definite trend in death rate. This is possibly because the data set for buildings with sprinklers is small. Also, in buildings with sprinklers, a simple correlation between death rate and property loss may not exist since property loss can be caused not only by fire but also by sprinkler action.

When comparing the FLRS 1983-90 data with the FLRS 1984-87 data, a definite smoothing of the trend can be seen. This may be attributed to the increase in sample size.

The FSR data is a subset of the FLRS data. As such, the number of fires and deaths in the FSR database should always be less than those in the FLRS database. In Tables 4 and 6, this is not the case for the intervals $3,000-$3,999 and $9,000-$9,999. This may be explained by the fact that definitions of sprinkler and alarm systems are not completely congruous between the two databases and interpretation may vary resulting in the same incident being reported differently in each of the databases.

ii) Extent of Fire Spread (Tables 14-15)

In these tables, death rates are shown in terms of the extent of fire spread, based on the FSR data. For buildings without sprinklers (Table 14), there is a noticeable jump in death rate from "Confined to Object" to "Confined to Floor", corresponding to the change from non-flashover to flashover fires. For buildings with sprinklers (Table 15), the results also show that there is a jump in death rate from "Confined to Object" to "Confined to Floor". However, with sprinkler protection, most fires are confined to the room of fire origin.

It should be noted that the FSR data, as was mentioned earlier, is biased towards significant fires. The number of "non-flashover" and "flashover" fires that can be derived from Table 14 for buildings without sprinklers, based on the extent of fire spread, cannot be generalized. Table 14 can only be used as a reference for significant fires.

b) Office Buildings

i) Property Loss (Table 8-13)

When examining results for office buildings, it is clear that the sample size is too small to see any significant characteristics. The death rate is almost non-existent and therefore cannot be used to indicate any changes in fire size.

ii) Extent of Fire Spread (Tables 16-17)

The lack of numbers available also makes it difficult to see any trends. Nevertheless, the use of sprinklers does seem to limit fire spread to the room of fire origin for office buildings, as is the case for apartment buildings.

Table 2

Fires in Apartment Buildings: 1983-90
Without Sprinkler System [Using FLRS]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	8,166	9	1.10
1,000 - 1,999	1,311	7	5.34
2,000 - 2,999	727	7	9.63
3,000 - 3,999	425	0	0.00
4,000 - 4,999	236	3	12.71
5,000 - 5,999	414	9	21.74
6,000 - 6,999	165	3	18.18
7,000 - 7,999	124	4	32.26
8,000 - 8,999	134	4	29.85
9,000 - 9,999	59	2	33.90
10,000+	2,401	177	73.72
Total	14,162	225	15.89

Table 3

Fires in Apartment Buildings: 1983-90
With Sprinkler System [Using FLRS]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	4,464	3	0.67
1,000 - 1,999	466	1	2.15
2,000 - 2,999	236	2	8.47
3,000 - 3,999	132	0	0.00
4,000 - 4,999	77	2	25.97
5,000 - 5,999	105	1	9.52
6,000 - 6,999	38	0	0.00
7,000 - 7,999	37	1	27.03
8,000 - 8,999	30	0	0.00
9,000 - 9,999	16	0	0.00
10,000+	395	21	53.16
Total	5,996	31	5.17

Table 4

Fires in Apartment Buildings: 1984-87
Without Sprinkler System [Using FLRS]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	4,096	4	0.98
1,000 - 1,999	642	4	6.23
2,000 - 2,999	355	5	14.08
3,000 - 3,999	207	0	0.00
4,000 - 4,999	118	3	25.42
5,000 - 5,999	188	5	26.60
6,000 - 6,999	80	1	12.50
7,000 - 7,999	66	1	15.15
8,000 - 8,999	66	2	30.30
9,000 - 9,999	26	1	38.46
10,000+	1,083	87	80.33
Total	6,927	113	16.31

Table 5

Fires in Apartment Buildings: 1984-87
With Sprinkler System [Using FLRS]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	2,192	1	0.46
1,000 - 1,999	236	1	4.24
2,000 - 2,999	117	1	8.55
3,000 - 3,999	66	0	0.00
4,000 - 4,999	36	2	55.56
5,000 - 5,999	49	1	20.41
6,000 - 6,999	24	0	0.00
7,000 - 7,999	18	0	0.00
8,000 - 8,999	18	0	0.00
9,000 - 9,999	10	0	0.00
10,000+	172	16	93.02
Total	2,938	22	7.49

Table 6

Fires in Apartment Buildings: 1984-87
Without Sprinkler System [Using FSR]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	91	3	32.97
1,000 - 1,999	22	3	136.36
2,000 - 2,999	15	1	66.67
3,000 - 3,999	6	3	500.00
4,000 - 4,999	20	3	150.00
5,000 - 5,999	8	1	125.00
6,000 - 6,999	2	1	500.00
7,000 - 7,999	4	0	0.00
8,000 - 8,999	2	1	500.00
9,000 - 9,999	17	8	470.59
10,000+	176	51	289.77
Total	363	75	206.61

Table 7

Fires in Apartment Buildings: 1984-87
With Sprinkler System [Using FSR]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	31	0	0.00
1,000 - 1,999	4	0	0.00
2,000 - 2,999	3	0	0.00
3,000 - 3,999	1	0	0.00
4,000 - 4,999	3	0	0.00
5,000 - 5,999	2	0	0.00
6,000 - 6,999	1	0	0.00
7,000 - 7,999	0	0	0.00
8,000 - 8,999	0	0	0.00
9,000 - 9,999	0	0	0.00
10,000+	6	2	333.33
Total	51	2	39.22

Table 8

Fires in Office Buildings: 1983-90
Without Sprinkler System [Using FLRS]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	342	0	0.00
1,000 - 1,999	52	0	0.00
2,000 - 2,999	23	0	0.00
3,000 - 3,999	22	0	0.00
4,000 - 4,999	14	0	0.00
5,000 - 5,999	22	0	0.00
6,000 - 6,999	6	0	0.00
7,000 - 7,999	2	0	0.00
8,000 - 8,999	2	0	0.00
9,000 - 9,999	1	0	0.00
10,000+	157	1	6.37
Total	643	1	1.56

Table 9

Fires in Office Buildings: 1983-90
With Sprinkler System [Using FLRS]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	296	0	0.00
1,000 - 1,999	64	0	0.00
2,000 - 2,999	30	0	0.00
3,000 - 3,999	15	0	0.00
4,000 - 4,999	6	0	0.00
5,000 - 5,999	20	0	0.00
6,000 - 6,999	3	0	0.00
7,000 - 7,999	4	0	0.00
8,000 - 8,999	6	0	0.00
9,000 - 9,999	2	0	0.00
10,000+	50	0	0.00
Total	496	0	0.00

Table 10

Fires in Office Buildings: 1984-87
Without Sprinkler System [Using FLRS]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	159	0	0.00
1,000 - 1,999	24	0	0.00
2,000 - 2,999	15	0	0.00
3,000 - 3,999	10	0	0.00
4,000 - 4,999	4	0	0.00
5,000 - 5,999	9	0	0.00
6,000 - 6,999	4	0	0.00
7,000 - 7,999	2	0	0.00
8,000 - 8,999	1	0	0.00
9,000 - 9,999	0	0	0.00
10,000+	59	1	16.95
Total	287	1	3.48

Table 11

Fires in Office Buildings: 1984-87
With Sprinkler System [Using FLRS]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	128	0	0.00
1,000 - 1,999	27	0	0.00
2,000 - 2,999	16	0	0.00
3,000 - 3,999	5	0	0.00
4,000 - 4,999	4	0	0.00
5,000 - 5,999	13	0	0.00
6,000 - 6,999	1	0	0.00
7,000 - 7,999	0	0	0.00
8,000 - 8,999	3	0	0.00
9,000 - 9,999	2	0	0.00
10,000+	18	0	0.00
Total	217	0	0.00

Table 12

Fires in Office Buildings: 1984-87
Without Sprinkler System [Using FSR]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	1	0	0.00
1,000 - 1,999	1	0	0.00
2,000 - 2,999	2	0	0.00
3,000 - 3,999	0	0	0.00
4,000 - 4,999	0	0	0.00
5,000 - 5,999	1	0	0.00
6,000 - 6,999	0	0	0.00
7,000 - 7,999	0	0	0.00
8,000 - 8,999	0	0	0.00
9,000 - 9,999	0	0	0.00
10,000+	17	1	58.82
Total	22	1	45.45

Table 13

Fires in Office Buildings: 1984-87
With Sprinkler System [Using FSR]

Property Loss ($)	No. of Fires	No. of Deaths	Deaths/1000 Fires
0 - 999	0	0	0.00
1,000 - 1,999	2	0	0.00
2,000 - 2,999	1	0	0.00
3,000 - 3,999	0	0	0.00
4,000 - 4,999	1	0	0.00
5,000 - 5,999	1	0	0.00
6,000 - 6,999	0	0	0.00
7,000 - 7,999	0	0	0.00
8,000 - 8,999	0	0	0.00
9,000 - 9,999	1	0	0.00
10,000+	3	0	0.00
Total	9	0	0.00

Table 14

Fire Damage / Probability in Apartment Buildings: 1984-87
Without Sprinkler System [Using FSR]

Extent of Fire Spread	No. of Fires	No. of Deaths	Deaths/1000 Fires
Confined to object	90	8	88.89
Confined to room of fire origin	134	29	216.42
Confined to floor of fire origin	75	21	280.00
Confined to other floors	28	7	250.00
Confined to entire building	24	7	291.67
Undetermined	12	3	250.00
Total	363	75	206.61

Table 15

Fire Damage / Probability in Apartment Buildings: 1984--87
With Sprinkler System [Using FSR]

Extent of Fire Spread	No. of Fires	No. of Deaths	Deaths/1000 Fires
Confined to object	26	1	38.46
Confined to room of fire origin	18	1	55.56
Confined to floor of fire origin	4	1	250.00
Confined to other floors	0	0	0.00
Confined to entire building	0	0	0.00
Undetermined	3	0	0.00
Total	51	3	58.82

Table 16

Fire Damage / Probability in Office Buildings: 1984-87
Without Sprinkler System [Using FSR]

Extent of Fire Spread	No. of Fires	No. of Deaths	Deaths/1000 Fires
Confined to object	5	0	0.00
Confined to room of fire origin	5	0	0.00
Confined to floor of fire origin	7	0	0.00
Confined to other floors	3	1	333.33
Confined to entire building	1	0	0.00
Undetermined	1	0	0.00
Total	22	1	45.45

Table 17

Fire Damage / Probability in Office Buildings: 1984-87
With Sprinkler System [Using FSR]

Extent of Fire Spread	No. of Fires	No. of Deaths	Deaths/1000 Fires
Confined to object	5	0	0.00
Confined to room of fire origin	2	0	0.00
Confined to floor of fire origin	0	0	0.00
Confined to other floors	0	0	0.00
Confined to entire building	0	0	0.00
Undetermined	2	0	0.00
Total	9	0	0.00

FIRE PROTECTION

a) Apartment Buildings (Tables 18-20)

The original intention of this analysis was to show the fire death rate of each of the four categories of fire protection as a ratio of the number of fire deaths occurring to the number of people living in that category. This would illustrate the relative significance of the data. Unfortunately, statistics on the number of people living in these categories do not exist. Consequently, the death rate is given as a ratio of the number of fire deaths to the number of fire incidents that occurred in each category.

During retrieval of these statistics, it became apparent that major discrepancies exist between the FLRS and the FSR databases with respect to alarm installation and activation. Again, a possible explanation could be the inconsistent definitions of alarm systems as are pointed out in the tables.

b) Office Buildings (Tables 21-23)

For office buildings, many of the above-noted observations apply. However, since there are no deaths recorded in this category, the tables do not demonstrate any patterns.

Table 18

Fire Deaths in Apartment Buildings: 1983-90
[Using FLRS]

	Death Rate	
	Sprinklered	Non-Sprinklered
Alarm*	18/3213=5.60E-03	81/4989=1.62E-02
No Alarm	13/2783=4.67E-03	145/9173=1.58E-02

* Alarm refers to incidents where an alarm system was available or installed but not necessarily used or activated.

Table 19

Fire Deaths in Apartment Buildings: 1984-87
[Using FLRS]

	Death Rate	
	Sprinklered	Non-Sprinklered
Alarm*	15/1435=10.45E-03	35/2184=1.60E-02
No Alarm	7/1503=4.66E-03	79/4743=1.67E-02

* Alarm refers to incidents where an alarm system was available or installed but not necessarily used or activated.

Table 20

Fire Deaths in Apartment Buildings: 1984-87
[Using FSR]

	Death Rate	
	Sprinklered**	Non-Sprinklered
Alarm*	1/39=2.56E-02	38/131=2.90E-01
No Alarm	1/12=8.33E-02	37/232=1.59E-01

* Alarm refers to incidents where an alarm system was installed in the area of fire origin.

** Sprinklered refers to a sprinkler system installed in the area of fire origin.

Table 21

Fire Deaths in Office Buildings: 1983-90
[Using FLRS]

	Death Rate	
	Sprinklered	Non-Sprinklered
Alarm*	0/264=0.00E+00	0/131=0.00E+00
No Alarm	0/232=0.00E+00	1/512=1.95E-03

* Alarm refers to incidents where an alarm system was available or installed but not necessarily used or activated.

Table 22

Fire Deaths in Office Buildings: 1984-87
[Using FLRS]

	Death Rate	
	Sprinklered	Non-Sprinklered
Alarm*	0/110=0.00E+00	0/52=0.00E+00
No Alarm	0/107=0.00E+00	1/235=4.26E-03

* Alarm refers to incidents where an alarm system was available or installed but not necessarily used or activated.

Table 23

Fire Deaths in Office Buildings: 1984-87
[Using FSR]

	Death Rate	
	Sprinklered**	Non-Sprinklered
Alarm*	0/4=0.00E+00	0/6=0.00E+00
No Alarm	0/2=0.00E+00	1/16=6.25E-02

* Alarm refers to incidents where an alarm system was installed in the area of fire origin.
** Sprinklered refers to a sprinkler system installed in the area of fire origin.

FIRE SERVICES

The time elapsed between the start of a fire and the instant when fire suppression begins is composed of five separate time steps:

(1) Alarm initiation or notification time starts with fire ignition and ends when the fire department gets the notification of the fire.
(2) Dispatch time is the time it takes for the first crew to be alerted of the fire after the alarm is received by the dispatcher.
(3) Preparation time is the time it takes the firefighters to get ready.
(4) Response or travel time is the time it takes the fire crew to travel to the scene of the fire. The response time can be retrieved from the FLRS.
(5) Set-up time begins when the firefighters arrive at the scene and ends when they begin fire suppression operations. This information was not available and had to be obtained through a combination of on-site timing and fire department enquiry.

All of the above information is useful because it provides an indication of the degree to which fire department response time affects the consequences of the fire (with respect to injury, deaths, and property loss). Two areas of fire service fall into the scope of this study: response time and set-up time.

a) Response Time

It is important to note that response time alone cannot measure the effectiveness of the fire service. The response time is complemented by a number of other factors:

(1) Average response time: dependent on incident location, region, response area and degree of hazard.
(2) Weighted average response time: gives specific focus to particular areas.
(3) Availability: measures how often response time is delayed because closest company is at another location.
(4) Initial response adequacy: measures the proportion of alarms for which the initial response is appropriate.
(5) Workload: measured in number of responses per day and average time working per day.

i) Apartment Buildings (Tables 24-27)

For units with or without sprinklers, the majority of responses took less than 8 minutes with the bulk of the occurrences being responded to in 2 to 3 minutes. The total dollar loss, however, increased significantly for buildings without sprinklers. Similar increases can be seen in the injury and death categories.

ii) Office Buildings (Tables 28-31)

With office buildings, the majority of responses took place in less than 5 minutes, as opposed to the 8 minutes for apartment buildings. This could be a result of the fact that most office space is centrally located and usually within close proximity to fire stations. Again, an increase in dollar losses was observed for buildings without sprinklers, although not as dramatic as for apartment buildings.

b) Set-Up Time

As part of the study, a reasonable estimate of a Fire Department's set-up time is also required. Used in the risk-cost assessment model, these estimates will help in the assessment of the probability of fire extinguishment at various stages of fire growth.

Set-up time, which is defined as the time from when the fire department arrives at the scene of the fire to when suppression of the fire begins, is controlled by many factors. These include:

- time of day,
- weather and traffic conditions,
- location of hydrant and size of water main,
- apparatus and man-power available,
- location and extent of fire,
- building height and type of construction,
- water supply,
- number and age of occupants,
- highrise plan availability,
- presence of sprinkler system,
- ability to ventilate,
- temperature (stack effect),
- life hazard,
- type of fire department (full-time, composite or volunteer).

Since variances in the above list can be large, the range of possible set-up times can also be large. It is therefore important to establish a range of set-up times that would take into account the best and worst case scenarios and would be based on factors that are similar to actual fire conditions.

It was decided that the best way to attack the problem of defining an accurate range of set-up times would be to go out into the field and time a crew setting up under specific, pre-defined conditions.

After consultation with the Fire Advisory Services Division of the Ontario Fire Marshal's Office, three scenarios were devised that would encompass the normal operations of a fire department fighting a highrise fire.

The Mississauga Fire Department provided the crew and facilities. This included six firefighters, two training officers, one pumper, one aerial and the Mississauga Fire Department Training Centre's mock highrise building.

All three scenarios had the following common components:

- four man crew including Captain,
- fourth storey level of fire origin,
- standpipe system with hose cabinets installed,
- standpipe Siamese connection on front of building,
- central corridor building type,
- extent of fire spread limited to room of fire origin,
- all access gained by stairwell.

Scenario No. 1: The firefighters arrived at the scene in a pumper, sized-up, and proceeded to the level of fire origin, using only the existing standpipe system (at 90-100psi) to suppress the fire. All windows were shut and three firefighters with air packs went into the building while the driver stayed with the vehicle. This evolution took 3 min 56 sec or approximately 4 min from arrival to suppression and represents a best-case scenario.

Scenario No. 2: The firefighters arrived at the scene to find the closest hydrant inoperable (the next closest hydrant was located 500 ft away), the floor of fire origin completely filled with smoke and the standpipe was dry. The crew proceeded to station a man at the operational hydrant and lay approximately 350 ft of 100 mm, high ball hose from the hydrant to the pumper and the remaining 150 ft with 65 mm hose from the pumper to the standpipe connection. This portion took 4 min 5 sec. At this point, the captain and one other firefighter went into the building where they began fire suppression activities. This portion took 1 min 28 sec for a total time of 6 min 33 sec. Although certainly not representative of the worst case scenario, the time gives an indication of the delay involved when certain conditions are less than ideal.

Scenario No. 3: This was proposed in order to estimate the set-up time when the type of vehicle and fire fighting tactics were changed. This time an aerial or truck with ladder apparatus was used and the fire fighting strategy turned from offensive to defensive. Given the varied time it takes to hook-up the hydrant to the vehicle, only the set-up time of the ladder was measured. This evolution, which included aerial set-up by remote control at the base of the ladder and then positioning the water nozzle toward the fire (i.e. suppression), took 3 min 17 sec.

Summary of Set-up Times

Scenario	Conditions	Time (min:sec)
1	- use of standpipe system only - clear visibility	3:56
2	- first hydrant inoperable - smoke-filled floor - standpipe dry	6:33
3	- aerial apparatus used	3:17

The second phase of the set-up time determination was a survey of fire departments across Ontario. The knowledge gained in the field was implemented in the construction of a questionnaire that addressed issues relevant to set-up time.

The questionnaire also addressed the last point of the aforementioned list of factors influencing set-up time – i.e. type of fire department. In Ontario, there are 656 fire departments of which 34 are full-time, 100 are composite (a combination of full-time and volunteers), and 522 are exclusively volunteer. The percentages are, respectively, 5%, 15% and 80%.

There can be great differences between full-time and volunteer fire departments. Full-time fire departments, usually located in large urban centres, are generally fully staffed and equipped. Firefighters from these departments are well-trained and conversant in highrise fire fighting tactics. Volunteer firefighters, on the other hand, are usually from rural areas and may not be trained in techniques of highrise fire fighting. In addition, equipment availability and water supply can also cause large discrepancies in set-up time.

In order to account for the discrepancies between fire departments, a list of fire departments was compiled to represent the distribution of full-time, composite and volunteer departments across Ontario (see Appendix C for the list). The questionnaire was then circulated to these fire departments and the differences in answers observed. Before the questionnaire was sent, a phone call was made to the department chief or deputy chief to request their cooperation.

Fire Department Set-up Time Questionnaire

Scenario: high-rise building, residential standpipe system with hose cabinets, standpipe Siamese connection on front of building, hydrant located 38 m away from front of building, pumper located 15 m from standpipe connection, one pumper with a crew of four, level of fire origin: fourth storey, building type: central corridor.

Set-up time definition: Set-up time will commence from the point of taking the hydrant, the pumper laying hose to the building, hooking into the Siamese connection for the standpipe system and charging it with water. The firefighters will proceed to lay out 38 mm hose from the standpipe cabinet to the apartment on fire and playing water. Set-up time will stop the instant water is played by the firefighters at the apartment.

For the given scenario:

1. What is the average set-up time for fire suppression operation?
2. What would the average set-up time be if:
   a) the building was an office building? or
   b) the fire originated on the 7th storey? 8th storey? or
   c) the building was of centre core construction? or
   d) the hydrant was further than 38 m away (next closest)?
3. What other factors affect set-up time? By how much?
4. What would be an average dispatch/preparation/travel time?
5. Indicate whether water supply line was 100 mm or 65 mm hose.

During the phone call stage, it became apparent that almost all of the volunteer fire departments had never been involved in any highrise building fires and usually did not even have highrise buildings in their geographical area. This is to be expected since the majority of volunteer departments are located in rural areas.

The results, therefore, are largely compiled from full-time and composite departments but will be representative since the areas which contain these types of departments are far more likely to have highrise buildings.

On the whole, the feedback was consistent and the questions were well answered.

Question No. 1 had a range of answers from 3-7 min but the average answer was approximately 4 min. For an office building (Question 2a), the set-up time was the same as an apartment building. When building height changed, the average increase in set-up time per floor was 1 min but the time decreased if a firefighters' elevator were available.

It was found that type of construction did not affect set-up time to a significant degree although, in an open concept office building, it would be much easier to locate the hose cabinets and, as a result, decrease the time to suppression.

The answers to Question 2d were not as consistent as the others. Some fire chiefs believed that the distance from the fire scene to the next closest hydrant should not make a difference in set-up time because it was the pump operator's responsibility on a four man crew and would not slow the overall set-up process. Others, however, felt that there should be an extra 10-15 sec allotted for every 15 m the hydrant was farther away from the scene of the fire.

Question No. 3 was not answered by any of the respondents as it was felt that too much guess work would be involved in estimating the influence of a list of factors on the set-up time.

The answers to Question No. 4 included the following: dispatch times ranged from 60-90 sec, preparation time ranged from 30-60 sec, and travel times ranged from 2-5 min. These figures are more representative of full-time fire departments since volunteers get notified of fires at their place of work or at home and get dressed on the run or after they arrive at the scene.

In general, the water supply line from the hydrant to the pumper would be 100 m while the line from the pumper to the Siamese connection would be 65 mm.

In conclusion, it is important to note that while it was possible to obtain actual numbers for many of the questions, conditions during a fire can be so varied that an exact prediction of a set-up time is impossible. It is far better to work with ranges that would take into account the factors of variance at a fire scene.

Table 24

Service in Apartment Buildings: 1983-90
No Sprinkler Installed [Using FLRS]

Response time minutes	No. of Fires	No. of Injuries	No. of Deaths	Fire Loss dollars
1	1,122	187	15	7,440,437
2	3,365	727	49	34,559,661
3	4,209	832	70	35,439,343
4	2,854	567	46	26,521,338
5	1,311	287	24	11,787,878
6	457	86	7	4,374,478
7	205	39	2	2,968,208
8	89	8	0	981,488
9	30	0	0	790,931
10	41	4	1	993,794
11	6	0	0	145,800
12	4	0	0	110,600
13	8	1	1	102,950
14	4	0	0	90,200
15	8	0	0	501,350
16	4	0	0	133,400
17	1	0	0	300
18	2	0	0	50,200
19	0	0	0	0
20+	22	2	0	235,716
Unknown	419	8	11	3,038,541
Total	14,161	2,748	226	130,266,613

Table 25

Service in Apartment Buildings: 1983-90
Sprinklers Installed [Using FLRS]

Response time minutes	No. of Fires	No. of Injuries	No. of Deaths	Fire Loss dollars
1	833	70	2	2,079,402
2	1,654	219	9	3,883,366
3	1,624	217	14	8,032,627
4	1,039	149	4	670,888
5	511	48	2	1,167,068
6	166	30	0	1,183,542
7	49	8	0	265,211
8	19	6	0	25,850
9	4	1	0	1,370
10	15	0	0	22,510
11	2	1	0	2,000
12	0	0	0	0
13	1	0	0	1
14	1	0	0	1,000
15	0	0	0	0
16	1	0	0	150
17	0	0	0	0
18	1	0	0	200
19	0	0	0	0
20+	33	5	0	45,580
Unknown	43	5	0	38,861
Total	5,996	759	31	17,419,626

Table 26

Fire Service in Apartment Buildings: 1984-87
No Sprinkler Installed [Using FLRS]

Response time minutes	No. of Fires	No. of Injuries	No. of Deaths	Fire Loss dollars
1	606	116	7	3,459,975
2	1,720	417	33	17,280,063
3	2,058	416	35	14,715,302
4	1,343	286	25	9,824,596
5	576	111	7	4,856,644
6	230	32	1	1,555,966
7	102	30	0	902,038
8	47	1	0	243,976
9	11	0	0	22,480
10	17	1	0	316,694
11	4	0	0	60,800
12	2	0	0	35,100
13	1	0	1	80,000
14	1	0	0	7,500
15	5	0	0	271,050
16	1	0	0	80,000
17	0	0	0	0
18	1	0	0	200
19	0	0	0	0
20+	3	0	0	4,151
Unknown	199	3	5	594,633
Total	6,927	1,413	114	54,311,168

Table 27

Fire Service in Apartment Buildings: 1984-87
Sprinkler Installed [Using FLRS]

Response time minutes	No. of Fires	No. of Injuries	No. of Deaths	Fire Loss dollars
1	432	7	2	719,722
2	906	33	7	2,071,955
3	758	35	10	2,581,235
4	438	25	2	1,500,679
5	244	7	1	441,479
6	75	1	0	182,946
7	32	0	0	213,235
8	12	0	0	8,200
9	2	0	0	1,250
10	1	0	0	300
11	0	0	0	0
12	0	0	0	0
13	1	1	0	1
14	0	0	0	0
15	0	0	0	0
16	1	0	0	150
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20+	5	0	0	29,726
Unknown	31	5	0	17,070
Total	2,938	114	22	7,767,948

Table 28

Fire Service in Office Buildings: 1983-90
No Sprinkler Installed [Using FLRS]

Response time minutes	No. of Fires	No. of Injuries	No. of Deaths	Fire Loss dollars
1	70	3	1	1,448,864
2	165	15	0	2,803,734
3	188	32	0	11,057,303
4	95	6	0	3,152,104
5	47	5	0	5,789,051
6	17	1	0	198,450
7	13	0	0	296,050
8	6	5	0	385,601
9	0	0	0	0
10	7	0	0	640,005
11	0	0	0	0
12	3	0	0	2,001
13	0	0	0	0
14	1	0	0	20,000
15	1	0	0	1,000
16	1	0	0	3,000
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20+	0	0	0	0
Unknown	29	0	0	85,999
Total	643	67	1	25,883,162

Table 29

Fire Service in Office Buildings: 1983-90
Sprinkler Installed [Using FLRS]

Response time minutes	No. of Fires	No. of Injuries	No. of Deaths	Fire Loss dollars
1	81	7	0	199,938
2	153	9	0	328,247
3	133	7	0	658,189
4	71	7	0	1,155,307
5	31	0	0	437,651
6	12	2	0	45,240
7	5	1	0	952,200
8	4	0	0	1,300
9	1	0	0	300
10	1	1	0	2,500
11	0	0	0	0
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20+	1	0	0	35
Unknown	3	0	0	86,722
Total	496	34	0	3,867,629

Table 30

Fire Service in Office Buildings: 1984-87
No Sprinkler Installed [Using FLRS]

Response time minutes	No. of Fires	No. of Injuries	No. of Deaths	Fire Loss dollars
1	40	0	1	849,208
2	88	9	0	1,645,891
3	86	11	0	2,962,580
4	31	3	0	835,702
5	17	3	0	243,400
6	4	0	0	57,150
7	5	0	0	126,400
8	2	5	0	361,400
9	0	0	0	0
10	2	0	0	350,000
11	0	0	0	0
12	1	0	0	0
13	0	0	0	0
14	1	0	0	20,000
15	0	0	0	0
16	1	0	0	3,000
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20+	0	0	0	0
Unknown	9	0	0	25,314
Total	287	31	1	7,480,045

Table 31

Fire Service in Office Buildings: 1984-87
Sprinkler Installed [Using FLRS]

Response time minutes	No. of Fires	No. of Injuries	No. of Deaths	Fire Loss dollars
1	43	2	0	91,026
2	76	1	0	142,069
3	56	5	0	255,908
4	25	1	0	561,305
5	6	0	0	43,100
6	5	0	0	40,450
7	1	0	0	800
8	1	2	0	0
9	1	0	0	300
10	0	1	0	25,000
11	0	0	0	0
12	1	0	0	5,000
13	0	0	0	0
14	0	0	0	0
15	0	0	0	0
16	0	0	0	0
17	0	0	0	0
18	0	0	0	0
19	0	0	0	0
20+	0	0	0	0
Unknown	2	0	0	2
Total	217	12	0	1,164,960

CONCLUSIONS AND RECOMMENDATIONS

In general, the database systems at the Office of the Fire Marshal were accessible and easy to use. Apart from the problems identified in the Introduction, all retrievals were successful. The FSR database contains a comprehensive documentation of fire statistics but, unfortunately, the amount of data it contains is not large enough to project general trends. The FLRS database contains a large quantity of data, but the document on which it is based, the Standard Fire Report, is in need of re-wording in order to eliminate some of its ambiguities.

With respect to the supplemental statistics, this study identified a need for more accessible data on the demographics of sprinkler and alarm systems as well as the need for statistics on office space. One information source, not explored but which may prove to be helpful, is the insurance industry which may have a breakdown of policy holders according to presence or absence of alarm and sprinkler systems.

When the results were analyzed, it became apparent that the databases are not large enough to show a clear breakdown of the type of fires. Nevertheless, the results still provide valuable information on fire incidence, the effects of alarm and sprinkler systems and the response time.

ACKNOWLEDGEMENTS

The authors would like to thank the NRCC Code Development Fund for its financial support, without which this study would not have been carried out; Mr. Doug Crawford, Chief of the Technical Consulting and Research Services, Office of the Fire Marshal of Ontario, for his support and his permission for an NRCC staff member to work at the OFMO during the summer of 1991.

The authors would also like to thank various people at the OFMO for their support during the course of this investigation, especially Mr. Boyd Finger, and the training crew at the Mississauga fire department for their work on set-up time. The responses by the various fire departments were also much appreciated.

Finally, the authors would like to thank Irene Nowakowski, Ministry of Treasury and Economics, for the information on apartment units.

Appendix A: Fire Reporting Documentation

Ministry of the Solicitor General
Ontario

Office of the Fire Marshal

7 Overlea Blvd.
3rd Floor
Toronto, Ontario
M4H 1A8

Response Report

A

RESPONSE LOCATION — CODE | AREA | S. AREA

DATE — YEAR | MONTH | DAY

TIME — HOUR | MIN.

FIRE DEPT. REFERENCE NO.

ATTENDING F.D.

RESPONSE LOCATION

RESPONSE TYPE

FIRE EXPLOSION

- ☐ 10 Rubbish Fire (No dollar loss)
- ☐ 11 Grass Fire (No dollar loss)
- ☐ 12 Chimney or Flue Fire (No dollar loss)
- ☐ 13 Furnace or Stove Malfunction
- ☐ 14 Explosion (No fire)
- ☐ 18 Assistance to other F.D.

PUBLIC HAZARD

- ☐ 20 Washdown (Hazardous products)
- ☐ 21 Natural Gas Leak
- ☐ 22 Propane Gas Leak
- ☐ 23 Radio-active Material Problem
- ☐ 29 Other Dangerous Good - Spill or Leak
- ☐ 30 Ruptured Water/Steam Pipe
- ☐ 31 Power Lines Down/Arcing
- ☐ 32 Bomb/Explosive Removal/Standby
- ☐ 39 Other (Public hazard)

RESCUE

- ☐ 40 Vehicle Extrication
- ☐ 41 Persons Trapped in Elevator
- ☐ 40 Other (Rescues)

ACCIDENT

- ☐ 50 Vehicle (No fire)
- ☐ 51 Home or Residential Property
- ☐ 52 Commercial or Industrial Property

RESUSCITATOR CALL

- ☐ 60 Asphyxia or Respiratory condition
- ☐ 61 Convulsions
- ☐ 62 Electric Shock
- ☐ 63 Traumatic Shock
- ☐ 64 Drowning
- ☐ 65 Heart Attack
- ☐ 66 Drug Related
- ☐ 68 Aid Not Required on Arrival
- ☐ 69 Other (Resuscitator call)

Suspected Condition

FALSE ALARM - MALICIOUS

- ☐ 70 Residential Occupancy
- ☐ 71 Educational Occupancy
- ☐ 79 Other/Malicious false alarms)

ALARM - NO FIRE

- ☐ 80 Sprinkler - Pressure Change
- ☐ 81 Detector Activated
- ☐ 82 Equipment Malfunction
- ☐ 83 Smoke Steam, etc. Mistaken for Fire
- ☐ 84 Unknown odour investigated
- ☐ 88 Alarm Accidental
- ☐ 89 Other (Alarm - No fire)

OTHER RESPONSE

- ☐ 90 Assistance to Police or Other Agencies
- ☐ 91 First-aid
- ☐ 95 Other Public Service
- ☐ 95 Authorized F.D. Activated Activity (Training etc.)

ALARM TO FIRE DEPARTMENT

- ☐ 1 Telephone to F.D. or Central Dispatch
- ☐ 2 Municipal Street Box System
- ☐ 3 Automatic System - Connection to F.D. or Dispatch
- ☐ 4 Manual System - Connection to F.D. or Dispatch
- ☐ 5 Automatic Sprinkler System - Connection to F.D. or Dispatch
- ☐ 6 Still Alarm (Verbal report to station)
- ☐ 7 Telephone from Other Emergency/Protection Agency
- ☐ 8 Radio
- ☐ 9 Other Than Above

RESPONSE TIME

RESPONDING PERSONNEL

MANHOURS — Total Manhours

BACK IN SERVICE — Hour | Min. — Time

RESCUES — Persons Rescued

CASUALTIES — Casualty Reports

DISTRICT

STATION

PLATOON

REMARKS _____

FIRE DEPARTMENT | **CHIEF** | **DATE**

Form FM 80A (Rev 11/88)

Do you require a supply of forms? YES ☐ QTY REQ'D _____

FIRE MARSHAL

Ontario

Ministry of the Solicitor General

Office of the Fire Marshal

[redacted] Overlea Blvd.
[redacted] Toronto, Ont.
[redacted] M4H 1A8

Casualty Report

B

FIRE DEPT. REFERENCE NO.	RESPONSE LOCATION CODE	AREA	S.AREA	DATE YEAR	MONTH	DAY	TIME HOUR	MIN.

CASUALTY NAME AND ADDRESS

CASUALTY NO.

STATUS
- ☐ 1. Firefighter
- ☐ 2. Occupant
- ☐ 3. Non-Occupant (Bystander, passerby, etc.)

SEX
- ☐ 1. Male
- ☐ 2. Female

AGE ☐ Years

PHYSICAL CONDITION OR STATUS (suspected)
- ☐ 1. Infant - Too Young to Act
- ☐ 2. Children Left Unattended
- ☐ 3. Under Restraint or Detention
- ☐ 4. Bedridden or Other Physical/Mental Handicap
- ☐ 5. Impaired - Alcohol } Provide Details in
- ☐ 6. Impaired - Drugs } Remarks Area
- ☐ 7. Asleep
- ☐ 8. Normal - Involved in Domestic/Household Activities
- ☐ 9. Normal - Involved in Leisure/Recreational Activities
- ☐ 10. Normal - Involved in Business/Occupational Activities
- ☐ 11. Unknown or Unclassified

ACTION OF CASUALTY (suspected)
- ☐ 1. Panic or Loss of Judgement
- ☐ 2. Attempting Escape
- ☐ 3. Responding to or Returning from Alarm
- ☐ 4. Involved in Rescue Activities
- ☐ 5. Involved in Firefighting Activities
- ☐ 6. Removing Endangered Property or Equipment
- ☐ 7. No Action
- ☐ 8. Unknown or Unclassified

CAUSE OF INJURY OR DEATH
- ☐ 1. Smoke or Fire
- ☐ 2. Explosion
- ☐ 3. Falling Debris
- ☐ 4. Building Collapse
- ☐ 5. Equipment Failure — Occurrence Related
- ☐ 6. Accident — Occurrence Related
- ☐ 7. Equipment Failure - Training Activity
- ☐ 8. Accident - Training Activity
- ☐ 9. Unknown or Unclassified

INJURY (observed or suspected)
- ☐ 1. Head, Neck or Spine Injury
- ☐ 2. Wounds - Incised, Lacerated, Puncture, etc.
- ☐ 3. Heart Attack or Stroke
- ☐ 4. Bone Injury or Fracture
- ☐ 5. Burns or Scalds
- ☐ 6. Asphyxia/Respiratory Condition
- ☐ 7. Injury to Muscle, Ligaments or Joints
- ☐ 8. Eye Injury
- ☐ 9. Traumatic Shock
- ☐ 10. Heat Illness, Cold Exposure or Fatigue
- ☐ 11. Minor Cuts or Bruises
- ☐ 12. Unknown or Unclassified

SEVERITY
- ☐ 1. Minor - Not Hospitalized - No Absence from Work
- ☐ 2. Serious - Hospitalized and/or Absence from Work
- ☐ 3. Fatal

CLOTHING: DID TYPE OF CLOTHING WORN BY CASUALTY ADD TO SEVERITY?
- ☐ 1. No
- ☐ 2. Yes (Provide details in remarks area)

IF CASUALTY IS A FIREFIGHTER PROVIDE THE FOLLOWING DETAILS

EMPLOYMENT STATUS
- ☐ 1. Full Time
- ☐ 2. Part Time (Volunteer)

FIREFIGHTING EXPERIENCE
☐ YEARS

HEIGHT
☐ CENTIMETRES

WEIGHT
☐ KILOGRAMS

CLOTHING/EQUIPMENT WORN AT THE TIME OF INJURY
- ☐ Helmet
- ☐ Helmet Liner
- ☐ Face Shield
- ☐ Other Eye Protection
- ☐ Coat (Turnout)
- ☐ Gloves (Mitts)
- ☐ Boots
- ☐ Hose Key Belt
- ☐ Breathing Apparatus (Self-contained)

REMARKS

FIRE DEPARTMENT	CHIEF	DATE

Form FM 81 (Rev 01/83)

Do you require a supply of forms? ☐ YES QTY REQ'D _____

FIRE MARSHAL COPY

Ontario Ministry of the Solicitor General — Office of the Fire Marshal

Fatality Report

D

H.O. FILE #	FATALITY #	RESPONSE LOCATION CODE	AREA	S. AREA	DATE YEAR	MONTH	DAY	TIME HOUR	MIN.

FATALITY NAME AND ADDRESS

H.O. USE

A - STATUS
- ☐ 1. Firefighter
- ☐ 2. Occupant
- ☐ 3. Non-Occupant (Bystander, passerby, etc.)

B - SEX
- ☐ 1. Male
- ☐ 2. Female

C - AGE ☐ Years

D - PHYSICAL CONDITION OR STATUS (suspected)
- ☐ 1. Infant - Too Young to Act
- ☐ 2. Children Left Unattended
- ☐ 3. Under Restraint or Detention
- ☐ 4. Bedridden or Other Physical/Mental Handicap
- ☐ 5. Impaired - Alcohol*
- ☐ 6. Impaired - Drugs*
- ☐ 7. Asleep
- ☐ 8. Normal - Involved in Domestic/Household Activities
- ☐ 9. Normal - Involved in Leisure/Recreational Activities
- ☐ 10. Normal - Involved in Business/Occupational Activities
- ☐ 11. Unknown or Unclassified*

E - ACTION OF CASUALTY (suspected)
- ☐ 1. Panic or Loss of Judgement
- ☐ 2. Attempting Escape
- ☐ 3. Responding to or Returning from Alarm
- ☐ 4. Involved in Rescue Activities
- ☐ 5. Involved in Firefighting Activities
- ☐ 6. Removing Endangered Property or Equipment
- ☐ 7. No Action
- ☐ 8. Unknown or Unclassified*

F - CAUSE OF DEATH
- ☐ 5. Burns or Scalds
- ☐ 6. Asphyxia

G - IGNITION OF CLOTHING OR OTHER FIBRES
- ☐ 1. Outer Clothing
- ☐ 2. Sleepwear
- ☐ 3. Underclothing
- ☐ 4. Costume
- ☐ 5. Bedding or Bed Linen
- ☐ 6. Mattress or Pillow
- ☐ 7. Upholstered Furniture
- ☐ 8. Not Applicable
- ☐ 9. Unknown or Unclassified*

H - TYPE OF FABRIC OR MATERIAL IGNITED
- ☐ 1. Cotton
- ☐ 2. Wool
- ☐ 3. Other Natural Fibre
- ☐ 4. Rayon/Nylon (Viscose)
- ☐ 5. Other Synthetic Fibres
- ☐ 6. Mixture of Fibres
- ☐ 7. Polyurethane
- ☐ 8. Rubber
- ☐ 9. Plastic
- ☐ 10. Not Applicable
- ☐ 11. Unknown or Unclassified*

I - CLOTHING: DID TYPE OF CLOTHING WORN BY CASUALTY ADD TO SEVERITY?
- ☐ 1. No
- ☐ 2. Yes*

J - FATALITY LOCATION
- ☐ 1. Room of Fire Origin
- ☐ 2. Floor of Fire Origin (Other Room)
- ☐ 3. Corridor of Floor of Fire Origin
- ☐ 4. Stairwell
- ☐ 5. Elevator
- ☐ 6. Other than Floor of Fire Origin*
- ☐ 7. Unknown*

IF FATALITY IS A FIREFIGHTER PROVIDE THE FOLLOWING DETAILS

K - EMPLOYMENT STATUS
- ☐ 1. Full Time
- ☐ 2. Part Time (Volunteer)

L - FIREFIGHTING EXPERIENCE ☐ YEARS

M - HEIGHT ☐ CENTIMETRES

N - WEIGHT ☐ KILOGRAMS

O - CLOTHING/EQUIPMENT WORN
- ☐ Helmet
- ☐ Helmet Liner
- ☐ Face Shield
- ☐ Other Eye Protection
- ☐ Coat (Turnout)
- ☐ Gloves (Mitts)
- ☐ Boots
- ☐ Hose Key Belt
- ☐ Breathing Apparatus (Self-contained)

REMARKS

* PROVIDE DETAILS IN REMARKS AREA

INVESTIGATOR DATE

Ontario

Ministry of the Solicitor General

Office of the Fire Marshal

[redacted] 7 Overlea Blvd.
[redacted] Toronto, Ont.
[redacted] M4H 1A8

Vehicle Fire Report

V.

FIRE DEPT. REFERENCE NO.

RESPONSE LOCATION — CODE | AREA | S.AREA

DATE — YEAR | MONTH | DAY

TIME — HOUR | MIN.

ATTENDING F.D.

RESPONSE LOCATION

RESPONSE TYPE

- ☐ 06 Vehicle Accident or Collision (with fire)
- ☐ 07 Vehicle Fire — Exposure
- ☐ 08 Vehicle Fire
- ☐ 09 Vehicle No Alarm Fire

VEHICLE TYPE

ROAD VEHICLE
- ☐ 01 Automobile
- ☐ 02 Small Truck (pickup, van, etc.)
- ☐ 03 Large Truck (Excluding Truck Trailer)
- ☐ 04 Automobile and Trailer Combination
- ☐ 05 Small Truck and Trailer Combination
- ☐ 06 Tractor Trailer or Truck Trailer Combination
- ☐ 07 Motorcycle
- ☐ 08 Bus or Trackless Trolley
- ☐ 09 Other Road Vehicle

RAIL VEHICLE
- ☐ 11 Railway Train
- ☐ 12 Subway Train
- ☐ 19 Other Rail Vehicle

WATERCRAFT
- ☐ 21 Private or Business
- ☐ 22 Commercial
- ☐ 23 Military

AIRCRAFT
- ☐ 31 Private or Business
- ☐ 32 Commercial
- ☐ 33 Military

MISC. OR SPECIALTY VEHICLE
- ☐ 41 Construction
- ☐ 42 Industrial
- ☐ 43 Agricultural
- ☐ 49 Other Misc. or Specialty Vehicle

MAKE, MODEL & YEAR

If Applicable

LICENSE NO. OR REGISTRATION

If Applicable

PRIMARY PURPOSE - (Transport of):
- ☐ 1 Passengers
- ☐ 2 Flammable Liquids
- ☐ 3 Compressed Flammable Gas
- ☐ 4 Other Dangerous Goods
- ☐ 5 Dangerous Goods & General Cargo
- ☐ 6 General Cargo
- ☐ 7 Mobile Utility or Service Vehicle
- ☐ 9 Other _____

VEHICLE FUEL OR ENERGY SOURCE
- ☐ 1 Gasoline
- ☐ 2 Diesel Fuel
- ☐ 3 Propane
- ☐ 4 Electricity
- ☐ 9 Other _____

AREA OF ORIGIN
- ☐ 91 Engine Area
- ☐ 92 Running Gear (wheels & braking systems)
- ☐ 93 Electrical Systems
- ☐ 94 Fuel Systems (fuel tank, etc.)
- ☐ 95 Operator Area (cockpit, bridge, etc.)
- ☐ 96 Passenger Area
- ☐ 97 Cargo Area
- ☐ 98 Other _____

ESTIMATED DOLLAR LOSS

Dollars Only

INSURANCE COVERAGE

☐ 1 - Yes ☐ 2 - No ☐ 9 - Unknown

CAUSE (suspected)
- ☐ 01 Arson
- ☐ 04 Riot or Civil Commotion
- ☐ 07 Vandalism
- ☐ 11 Children Playing
- ☐ 21 Design Deficiency
- ☐ 31 Misuse of Igniting Object
- ☐ 32 Misuse of Material Ignited
- ☐ 33 Misuse of Equipment
- ☐ 41 Mechanical/Electrical Failure
- ☐ 51 Vehicle Accident or Collision
- ☐ 52 Accidental
- ☐ 98 Undetermined
- ☐ 99 Other _____

ALARM TO FIRE DEPARTMENT
- ☐ 1 Telephone to F.D. or Central Dispatch
- ☐ 2 Municipal Street Box System
- ☐ 6 Still Alarm (verbal report to station)
- ☐ 7 Telephone from other Emergency/Protection Agency
- ☐ 8 Radio
- ☐ 9 Other _____

RESPONSE TIME — Minutes

RESPONDING PERSONNEL — Number

MANHOURS — Total Manhours

BACK IN SERVICE — Hour | Min. — Time

RESCUES — Persons Rescued

CASUALTIES — Casualty Reports

DISTRICT | **STATION** | **PLATOON**

OPERATOR, DRIVER, ETC. (If Applicable)

FAMILY NAME | GIVEN NAME | INITIALS

STREET OR LOT NO. | STREET NAME, LINE OR CONCESSION NO. | A-AVE. B-BLVD. C-CRESC. D-DRIVE L-LANE R-ROAD S-STREET Y-COURT X-OTHER | N - NORTH E - EAST W - WEST S - SOUTH

APT. NO. | CITY, TOWN, VILLAGE OR TOWNSHIP

OWNER (Complete only if different from above)

COMPANY OR FAMILY NAME

STREET OR LOT NO. | STREET NAME, LINE, OR CONCESSION NO. | A-AVE. B-BLVD. C-CRESC. D-DRIVE L-LANE R-ROAD S-STREET Y-COURT X-OTHER | N - NORTH E - EAST W - WEST S - SOUTH

APT. NO | CITY, TOWN, VILLAGE OR TOWNSHIP

REMARKS:

FIRE DEPARTMENT | CHIEF | DATE

FORM FM82 (NEW 01/83)

Do you require a supply of forms? ☐ YES QTY. REQ'D. _____

FIRE MARSHAL COPY

Ontario

Ministry of the Solicitor General

Office of the Fire Marshal

7 Overlea Blvd
3rd Floor
Toronto, Ontario
M4H 1A8

Standard Fire Report

F

FIRE DEPT. REFERENCE NO.

RESPONSE LOCATION: CODE | AREA | S AREA

DATE: YEAR | MONTH | DAY

TIME: HOUR | MIN

ATTENDING F.D.

PROPERTY CLASSIFICATION

COMPLEX

OCCUPANCY STATUS

- 1 Occupied
- 2 Unoccupied
- 3 Occupied - Seasonal Use
- 4 Unoccupied - Seasonal Use
- 5 Vacant
- 6 Under Demolition
- 7 Under Construction
- 8 Not Applicable

OWNERSHIP STATUS

- 01 Owned & Occupied by Fed. Gov.
- 02 Owned & Occupied by Prov. Gov.
- 03 Owned & Occupied by Mun. Gov.
- 11 Leased to Fed. Gov.
- 12 Leased to Prov. Gov.
- 13 Leased to Mun. Gov.
- 21 Owned by Fed. Gov. - Leased to Others
- 22 Owned by Prov. Gov. - Leased to Others
- 23 Owned by Mun. Gov. - Leased to Others
- 34 Indian Reservation
- 99 All Other

BUILDING OR STRUCTURE HEIGHT

Floor(s) - Storey(s)

or

Metres

or

998 Not Applicable

LEVEL OF ORIGIN

Floor - Storey

or

- 96 Basement - Below Ground Level
- 97 Roof Level
- 98 Not Applicable
- 99 Unknown

AREA OF ORIGIN

SOURCE OF IGNITION - IGNITING OBJECT

FUEL OR ENERGY ASSOCIATED WITH SOURCE OF IGNITION

- 1 Gasoline
- 2 Diesel Fuel
- 3 Propane
- 4 Electricity
- 5 Fuel Oil
- 6 Natural Gas
- 7 Wood
- 8 Not Applicable
- 9 Other

OBJECT OR MATERIAL FIRST IGNITED

PROTECTION FACILITIES/SYSTEMS

AVAILABLE OR INSTALLED	USED OR ACTIVATED	
1	2	Sprinkler System*
1	2	Fixed System Other Than Sprinkler*
1	2	Standpipe System
1	2	Extinguishers
1	2	Outside Hydrant

DETECTION SYSTEMS

INSTALLED	ACTIVATED	
1	2	A.F.D.S. Heat*
1	2	A.F.D.S. Smoke, Etc.*
1	2	Protection & Detection Combined

*If Partial System, Provide Details in Remarks Area.

ESTIMATED DOLLAR LOSS

Dollars Only

INSURANCE COVERAGE

1 - Yes 2 - No 9 - Unknown

CAUSE (suspected)

- 01 Arson
- 04 Riot or Civil Commotion
- 07 Vandalism
- 11 Children Playing
- 21 Design Deficiency
- 22 Construction Deficiency
- 23 Installation Deficiency
- 31 Misuse of Igniting Object
- 32 Misuse of Material Ignited
- 33 Misuse of Equipment
- 41 Mechanical/Electrical Failure
- 51 Vehicle Accident or Collision
- 52 Accidental
- 98 Undetermined
- 99 Other

RESPONSE TYPE

- 01 Fire
- 02 No-Alarm Fire
- 03 Exposure Fire

ALARM TO FIRE DEPARTMENT

- 1 Telephone to F.D. or Central Dispatch
- 2 Municipal Street Box System
- 3 Automatic System - Connection to F.D. or Dispatch
- 4 Manual System - Connection to F.D. or Dispatch
- 5 Automatic Sprinkler System - Connection to F.D. or Dispatch
- 6 Still Alarm (Verbal report to station)
- 7 Telephone from Other Emergency/Protection Agency
- 8 Radio
- 9 Other

RESPONSE TIME Minutes

RESPONDING PERSONNEL Number

MANHOURS Total Manhours

BACK IN SERVICE Hour | Min — Time

RESCUES Persons Rescued

CASUALTIES Casualty Reports

DISTRICT **STATION** **PLATOON**

FIRE DEPARTMENT **CHIEF** **DATE**

FMSR REV. 78

Do you require a supply of forms? YES ☐ QTY REQ'D

FIRE MARSHAL COPY

25827

FIRE LOCATION

STREET OR LOT NO.	STREET NAME, LINE OR CONCESSION NO.	A-AVE. B-BLVD. C-CRESC. D-DRIVE L-LANE R-ROAD S-STREET Y-COURT X-OTHER	N-NORTH E-EAST W-WEST S-SOUTH
APT. NO.	CITY, TOWN, VILLAGE OR TOWNSHIP		

OWNER OR OWNER OCCUPANT

COMPANY OR FAMILY NAME	GIVEN NAME	INITIALS	OWNER ☐ 6	OWNER OCCUPANT ☐ 7

OCCUPANTS/PRIMARY WITNESSES

COMPANY OR FAMILY NAME	GIVEN NAME	INITIALS	OCCUPANT	PRIMARY WITNESS
			☐ 8	☐ 9
			☐	☐
			☐	☐
			☐	☐
			☐	☐
			☐	☐
			☐	☐

FIRE DEPARTMENT USE

A	B	C
D	E	F
G	H	I

REMARKS

FIRE SAFETY REPORT

Hotel ID No.

H.Q. File No.

Response Location Code | Area | S. Area

Date

Time

Fire Location (Street Address)

Property Classification

Material Contributing to Fire Severity

Incendiary Device or Source of Ignition

A. PROTECTION FACILITIES/SYSTEMS (IN THE AREA OF FIRE ORIGIN)

Installed	Operational	Activated	Effective
☐ 1. Sprinkler System	☐	☐	☐
☐ 2. Fixed System other than Sprinkler	☐	☐	☐
☐ 3. Standpipe System	☐	☐	☐
☐ 4. Fire Extinguishers	☐	☐	☐
☐ 5. Other	☐	☐	☐
☐ 6. None			

Remarks

B. DETECTION SYSTEMS (IN THE AREA OF FIRE ORIGIN)

Installed	Operational	Activated
☐ 1. Automatic Fire Detection System Heat	☐	☐
☐ 2. Automatic Fire Detection System Smoke	☐	☐
☐ 3. Protection and Detection Combined	☐	☐
☐ 4. Smoke Alarm - Local (Battery)*	☐	☐
☐ 5. Smoke Alarm - Local (Hardwired)*	☐	☐
☐ 6. Other*	☐	☐
☐ 7. None		

Remarks*

C. WALL CONSTRUCTION (IN THE AREA OF FIRE ORIGIN)

Structural	Covering	Finish
☐ 1. Wood Stud	☐ 1. Gypsum Board	☐ 1. Paint
☐ 2. Metal Stud	☐ 2. Wood Panel	☐ 2. Paper
☐ 3. Masonry	☐ 3. Fibre Board	☐ 3. Stucco
☐ 4. Concrete	☐ 4. Plaster on Metal Lath	☐ 4. Wood Panel
☐ 5. Undetermined	☐ 5. Plaster on Wood Lath	☐ 5. Carpet
	☐ 6. None	☐ 6. Other*
	☐ 7. Undetermined	☐ 7. None
		☐ 8. Undetermined

Remarks*

D. CEILING CONSTRUCTION (IN THE AREA OF FIRE ORIGIN)

Structural	Covering	Finish
☐ 1. Wood Joist	☐ 1. Gypsum Board	☐ 1. Paint
☐ 2. Steel Joist	☐ 2. Wood	☐ 2. Paper
☐ 3. Concrete	☐ 3. Fibre Board	☐ 3. Stucco
☐ 4. Undetermined	☐ 4. Plaster on Metal Lath	☐ 4. Fibre Tile
	☐ 5. Plaster on Wood Lath	☐ 5. Mineral Tile
	☐ 6. Plaster on Gypsum Lath	☐ 6. Other*
	☐ 7. None	☐ 7. None
	☐ 8. Undetermined	☐ 8. Undetermined

Remarks*

FIRE SAFETY REPORT

E. FIRST FLOOR AREA

- ☐ 1. Less than 100 m^2
- ☐ 2. 100 to 600 m^2
- ☐ 3. Over 600 to 2000 m^2
- ☐ 4. Over 2000 m^2

F. EXTENT OF FIRE AND SMOKE DAMAGE

Fire	Smoke
☐ 1.	☐ 1. Object of Fire Origin
☐ 2.	☐ 2. Room of Fire Origin
☐ 3.	☐ 3. Floor of Fire Origin
☐ 4.	☐ 4. Other Floors*
☐ 5.	☐ 5. Entire Building

Remarks*

G. CONTAINMENT DEFICIENCIES (IN THE AREA OF FIRE ORIGIN)

1. Was door blocked open? ☐
2. Was door left open? ☐
3. Was door closed properly? ☐
4. Was fire damper provided? ☐
5. Was fire damper inoperative? ☐
6. Was enclosure damaged prior to fire? ☐
7. Was enclosure incomplete? ☐
8. Was enclosure damaged by fire? ☐
9. Did mechanical ventilation assist fire spread? ☐
10. Did mechanical ventilation assist smoke spread? ☐

Remarks*

H. EARLY WARNING AND ALARM SYSTEMS (ENTIRE BUILDING)

Installed	Operational	Activated
☐ 1. Building Fire Alarm System	☐	☐
☐ 2. Building Voice Communication System	☐	☐
☐ 3. Interconnected Smoke Alarms	☐	☐
☐ 4. None		

I. FIRE SAFETY PLANS

- ☐ 1. Fire Safety Plan Instituted?
- ☐ 2. Fire Safety Plan Posted?
- ☐ 3. None

J. EXIT FACILITY (FROM THE FIRE FLOOR)

Installed	Obstructed		Remarks
☐ 1.	☐ 1.	One Exit	
☐ 2.	☐ 2.	Two Exits	
☐ 3.	☐ 3.	More than Two	
☐ 4.	☐ 4.	Undetermined	
	☐ 5	None	

K. RESPONSE AND ACTIONS OF OCCUPANTS OTHER THAN INJURED (Investigators' Opinion)

1. Was warning satisfactorily received? ☐
2. Was the warning delayed? ☐
3. Were they aware of Fire Emergency Plan? ☐
4. Did they follow Fire Emergency Plan? ☐
5. Did they exit from the Building? ☐
6. Were they able to use the available exit(s) at the time of escape? ☐

Remarks*

L. OCCUPANT DATA

1. Estimated number of persons in the building immediately prior to the fire: ____
2. Were there any fatalities? ☐
3. Were there any injuries? ☐

M. RESPONSE AND ACTIONS OF INJURED OCCUPANTS (Investigators' Opinion)

1. Was warning satisfactorily received? ☐
2. Was the warning delayed? ☐
3. Were they aware of Fire Emergency Plan? ☐
4. Did they follow Fire Emergency Plan? ☐
5. Did they exit from the Building? ☐
6. Were they able to use the available exit(s) at the time of escape? ☐

Remarks*

Appendix B: Apartment Dwelling Statistics

ONTARIO MINISTRY OF TREASURY AND ECONOMICS

SECTORAL AND REGIONAL POLICY BRANCH
CENSUS DATA RETRIEVAL SYSTEM
CENSUS DIVISION: 0 PROVINCE OF ONTARIO
1986 CENSUS FILE: HH4B - PART 1 / TENURE: TOTAL
PRIVATE HOUSEHOLDS BY TYPE OF HOUSEHOLD (12) BY STRUCTURAL TYPE OF DWELLING (11), BY TENURE (3)

TYPE OF HOUSEHOLD	TYPE OF STRUCTURE										
TYPE OF HOUSEHOLD	TOTAL DWELLIN	SINGLE DETACHE	APT 5+ STOREYS	DOUBLE HOUSE	ROW HOUSE	APT <5 STOREYS	DUPLEX	HS/ATTC TO NON-R BUILDING	TOT OTH OTHER DWELLNG	MOBILES	TOTAL MOVABLE DWELLNG
TOT PRIV HHLDS	3221725	1850570	525780	212975	176535	355895	72830	15620	833860	10635	11515
TOT FAM HHLDS	2400110	1568690	249195	181275	148710	169800	43345	10425	553550	7980	8470
ONE-FAM HHLDS	2355750	1559930	246445	174210	145565	168150	42825	10215	540965	7930	8415
PRIM FAM HHLDS	2317705	1534995	243115	170365	143220	165690	42035	9985	531295	7835	8300
HUS-WIFE HHLDS	2058670	1424805	196795	149795	109310	128210	33740	8530	429595	430	7475
LONE PAR HHLDS	259040	110190	46320	20570	33910	37480	8295	1455	101700	790	825
SECONDARY HHLDS	38045	24940	3335	3845	2330	2460	790	230	9660	95	120
HUS-WIFE HHLDS	26785	18500	2040	2775	1270	1445	500	175	6165	65	80
LONE PAR HHLDS	11265	6435	1295	1070	1065	1015	295	55	3495	30	35
MULT FAM HHLDS	44360	28955	2750	7065	3155	1650	525	210	12595	50	55
NON-FAM HHLDS	821620	281680	276580	31700	27830	186105	29480	5195	280310	2660	3050
ONE PERSON ONLY	679645	209000	241720	21770	17805	159025	23695	3995	225280	2280	2640
TWO + PERSONS	141975	52680	34860	9930	10025	27075	5790	1205	54025	380	405

SOURCE: STATISTICS CANADA, CENSUS OF CANADA

Appendix C: Fire Department Survey List

Appendix C

City/Town	Fire Chief	Phone #	Status
Toronto	D.C.Underwood	:(416)392-0151	F.T.
Dresden	R.Law	:(519)683-4422	Vol.
Wilmot	A.Weiler	:(613)743-4123	Vol.
Caradoc	L.Laughton	:(519)264-1671	Vol.
Simcoe	R.Shafto	:(519)426-4115	Vol.
Milton	D.C.Tenson	:(416)878-9251	Comp.
Dryden	L.Maltais	:(807)223-6244	F.T.
Fort Frances	R.Fulford	:(807)274-9841	Comp.
Sudbury	G.Burke	:(705)674-8524	Comp.
Blind River	F.Main	:(705)356-9888	Vol.
Iroquois Falls	A.Towsley	:(705)258-3624	Vol.
Georgetown	B.Cuningham	:(416)873-2600	Comp.
Sturgeon Falls	R.Savage	:(705)753-1106	Comp.
Ottawa	D.C.Rainboth	:(613)564-8035	F.T.
Napanee	T.Kimmett	:(613)354-4343	Comp.
Brockville	H.Tulk	:(613)342-2313	Comp.
Timmins	A.Shaefer	:(705)264-4338	Comp.
Renfrew	R.Foster	:(613)432-2811	Comp.
Penetang.	E.Light	:(705)549-2935	Vol.
Brampton	D.Clarke	:(416)874-2723	F.T.
Mississauga	G.Bentley	:(416)275-3800	F.T.

Aurora	F. Bolsby	:(416)727-1375	Comp.
North Bay	D.C.Cundari	:(705)474-4493	F.T.
Barrie	D.C.Lemieux	:(705)728-1277	Comp.

Note: Not all Fire Chiefs could be reached for the fire department survey.