ICING OF WIRES IN CANADA

by

Donald W. Boyd
Meteorological Service of Canada
assigned to the
Division of Building Research
National Research Council of Canada, Ottawa

ABSTRACT

A progress report on the collection of data on the accumulation of ice on wires and other structures in Canada. Tentative conclusions about the relative severity of icing loads for use in the design of communication and power transmission lines in various parts of the country are presented.

The National Research Council of Canada in Ottawa and the Canadian Meteorological Services have both received many inquiries in recent years about the maximum ice loads that should be expected on wires and towers in various parts of our country. Most of these inquiries were from persons concerned with the design of high voltage transmission lines or towers for the support of some kind of antennae. It was natural to refer them to the Canadian Electrical Code, Part III (1) for overhead wiring or to the Canadian Standards Association, Standard S37 (2) for antenna towers for the legal requirements for icing design loads, and to the Meteorological Branch for statistics on the number of days or hours with freezing precipitation. Unfortunately these references were not consistent.

The Canadian Standards Association is a voluntary organization including many committees and subcommittees each responsible for drafting or revising some standard, or part of a standard. The Canadian Electrical Code and the Standard on Antenna Towers and Antenna Supporting Structures are two of their publications. Each contains a map of Canada showing three "Loading Zones." These two maps, however, do not agree nor do either of them resemble the map of frequency of freezing precipitation. It was obvious that someone should look into this problem in the hope that the CSA maps could be made consistent with each other and compatible with the data on freezing precipitation.

The CSA maps should indicate the ice thickness to be used in design calculations. The ideal information for the designer would be the thickness and density of ice that had some very small probability of being exceeded. Observations of both thickness and density are scarce and the long records needed for statistical analyses are lacking. It will be necessary, therefore, to use whatever thickness reports can be found and assume a maximum density to be on the safe side.

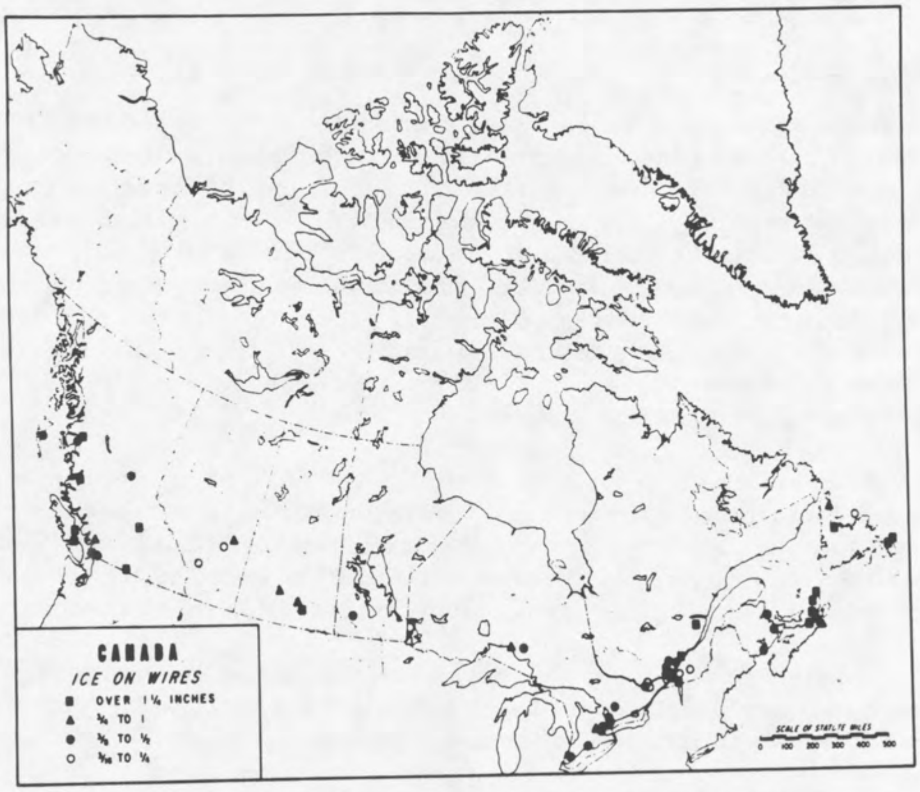


Figure 1. Ice thicknesses on wires

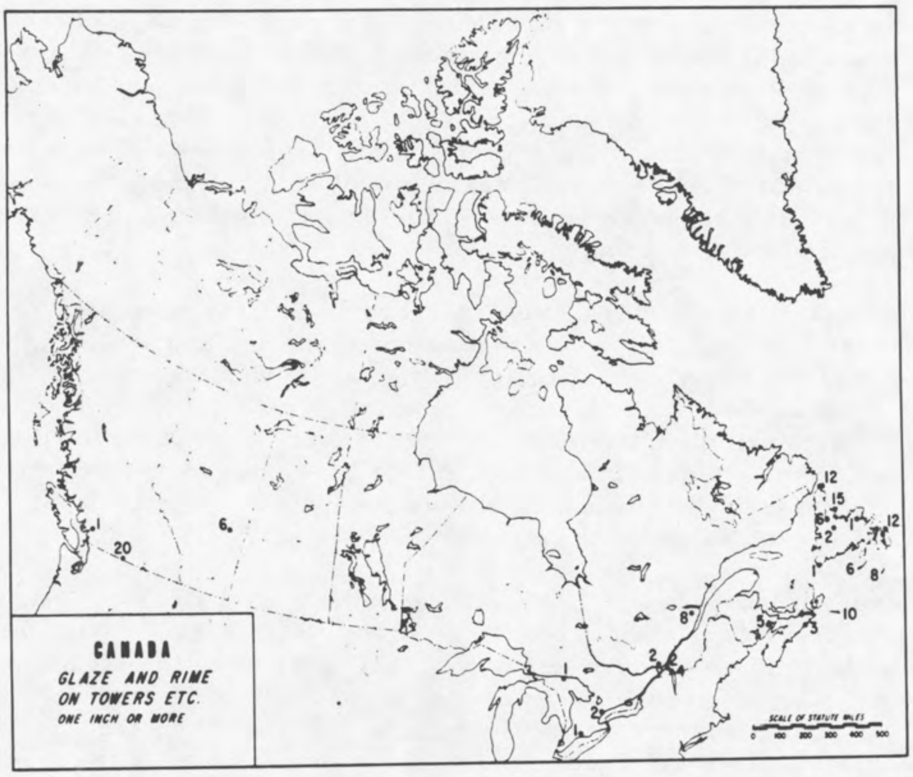


Figure 2. Ice thicknesses on other structures.

SOURCES OF INFORMATION

There are several possible sources of information about ice thicknesses. Perhaps the most obvious is the Meteorological Branch which collects weather observations from over 2000 locations in Canada. At most of these stations the relatively infrequent reports of freezing precipitation and of ice thicknesses have been entered in the "Remarks" column of the weather report form and have not been abstracted or summarized. At over 250 stations where weather observations are taken every hour the occurrences of freezing precipitation are recorded on punched cards but the thicknesses of accumulated ice are only available from the "Remarks" in the original reports. So far the time needed to examine the "Remarks" for ice thicknesses has not been available.

A second possible source of information is the files of all the communication and power companies in the country who presumably have records or correspondence about all the icing storms that damaged their lines. Probably the most serious objection to using this source is the difficulty of finding the useful information in the voluminous files from many years and for many companies.

A third possibility is to consider new information and current weather. If the assistance of many people could be enlisted, then a little work from each of them might provide enough information in a few years.

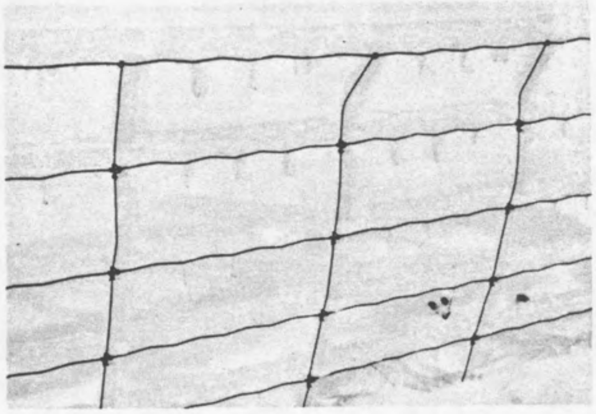
This last source of information seemed to be the most promising. Early in 1964 the Division of Building Research drew up an "Icing Report Form" and the Subcommittee on General Requirements of the CSA Committee on Aerial Joint Use of Poles arranged for the distribution of over 1800 copies of the form to telephone, telegraph, electric power and other companies and commissions. It was hoped that all the power and communication organizations in the country would report the ice thickness for any storm that damaged any of their equipment. The use of damage as a criterion for reporting icing storms would naturally eliminate all the minor occurrences of freezing precipitation and at the same time ensure at least two reports (one from a telephone company and one from a power company) of any major icing storm.

During the last five winters some 150 reports of icing have been received. A number of these reported only hoar frost or quite thin ice and no damage. If the ice was only 1/8 of an inch thick or less, the report was ignored. This left 75 reports of icing on wires and 50 reports of icing on poles, towers and similar structures. Some information has been abstracted from each of these reports and is presented in the tables. In addition, Table I includes eleven reports of snow adhering to wires in British Columbia and two reports of hoar frost reported to have broken wires on the Prairies.

With so few reports it was impossible to do any statistical analysis and, therefore, the reports were simply plotted on maps. In Figure 1, symbols have been used to indicate the ice thicknesses on wires. Sixteen of the tabulated reports were not plotted because they were too close to other plotted values and the snow and hoar frost reports were also omitted. In Figure 2, the ice thicknesses on other structures were plotted in whole inches. Seven of the tabulated reports were not plotted because they were too close to other plotted values, and

(a)

(b)



(a) Glaze ice on twig, Gander (Courtesy of J. A. Peach).

(b) Glaze ice on wire fence, Orangeville (Courtesy of D. A. Stevenson).

(c) Glaze ice on guy cables, Conception Bay (Courtesy of Northern Electric Co.).

(d) Rime ice on tower, Osoyoos (Courtesy of A. B. Sanderson & Co.).

(c)

(d)

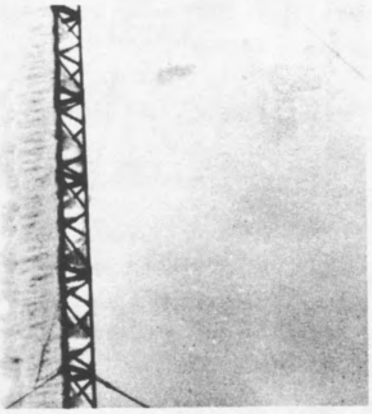


Figure 3

the 21 reports of less than one inch were omitted.

TYPES OF ICE

Before considering the available data on freezing precipitation it might be well to describe the different kinds of ice that can form on wires or towers.

If rain falls on objects that are at below-freezing temperatures or if rain falls through below-freezing air and becomes supercooled, then at least part of the rain-water will freeze onto the object it strikes. Less than half (usually much less) will freeze on contact, but, if the air temperature is low enough, most of the water will freeze before running off. This process produces dense ice which has relatively few bubbles and is often quite clear. This is usually called glaze or clear icing. Density may be as high as 0.8 or 0.9 gm/cc. The same phenomena result with drizzle.

If the water drops are very small, as in fog or cloud, and if the temperature is well below freezing, then a larger portion of each droplet will freeze where it lands. The resulting ice will consist of discrete ice granules cemented together. This is called rime. Density may be as low as 0.2 or 0.3 gm/cc, but is sometimes much higher.

Rime and glaze are, therefore, formed by the same processes. The difference between them depends mainly on the amount of air entrapped within the mass of ice and, hence, on the density. Glaze is favoured by large drops, slight supercooling and rapid accretion, and usually results from freezing rain or drizzle. Rime is favoured by small droplets, considerable supercooling and slow accretion, and usually forms in fog or cloud. Both are illustrated in Figure 3.

Hoar frost, on the other hand, is formed by the direct deposition of vapour to form ice crystals without going through a liquid state. Snow flakes are formed by the same process and the results are very similar: light, fluffy and feathery. Density is usually much less than 0.1 gm/cc unless some melting has occurred. Such light deposits would not be expected to cause any mechanical damage and hence hoar frost is really outside the area considered here. In high voltage transmission lines, however, hoar frost may be important because it tends to increase corona losses.

FREEZING PRECIPITATION STATISTICS

As was mentioned earlier, the Meteorological Branch has compiled some statistics on the frequency of freezing precipitation that usually produces glaze icing. The Climatology Division prepared a map a few years ago showing the average annual number of hours with freezing precipitation. Last year the data were updated and two maps were published by McKay and Thompson (3). The first, showing average annual number of hours with freezing precipitation, agreed in broad outline with the earlier map although there were differences in detail. The second map showed the ratio of the hours of freezing rain to the total hours of freezing precipitation. This meant that the number of hours of freezing rain and the number of hours of freezing drizzle were both available separately instead of merely the total hours of freezing rain and drizzle together.

The question is: Can these data on hours of freezing precipitation be used to indicate the relative severity of glaze icing in different parts of our country? Perhaps the logical way to attack this problem is to try to determine the amount of rain or drizzle in each hour and also the wind speed for each hour and to use these to estimate the accumulation of ice. A start has been made along these lines in the Climatology Division of the Meteorological Service but since it involves a detailed study, hour by hour of many storms at many stations, it may be some time before any results can be published.

In the meantime something should be done to improve the CSA maps. The only relevant and readily available data are the hours of freezing rain and of freezing drizzle. There is no doubt that freezing rain produces more ice per hour on the average than freezing drizzle. How much more is not known, but it has been assumed (quite arbitrarily) that freezing rain on the average will produce three times as much ice as freezing drizzle.

The data which McKay and Thompson used for their maps was made available to the author. The hours of freezing drizzle were divided by three and added to the hours of freezing rain and a map of the resulting index drawn up. This map (Figure 4) indicates very high values over the eastern part of Newfoundland, moderate values in the Maritimes, St. Lawrence and Great Lakes areas, and relatively light values over most of the rest of the country.

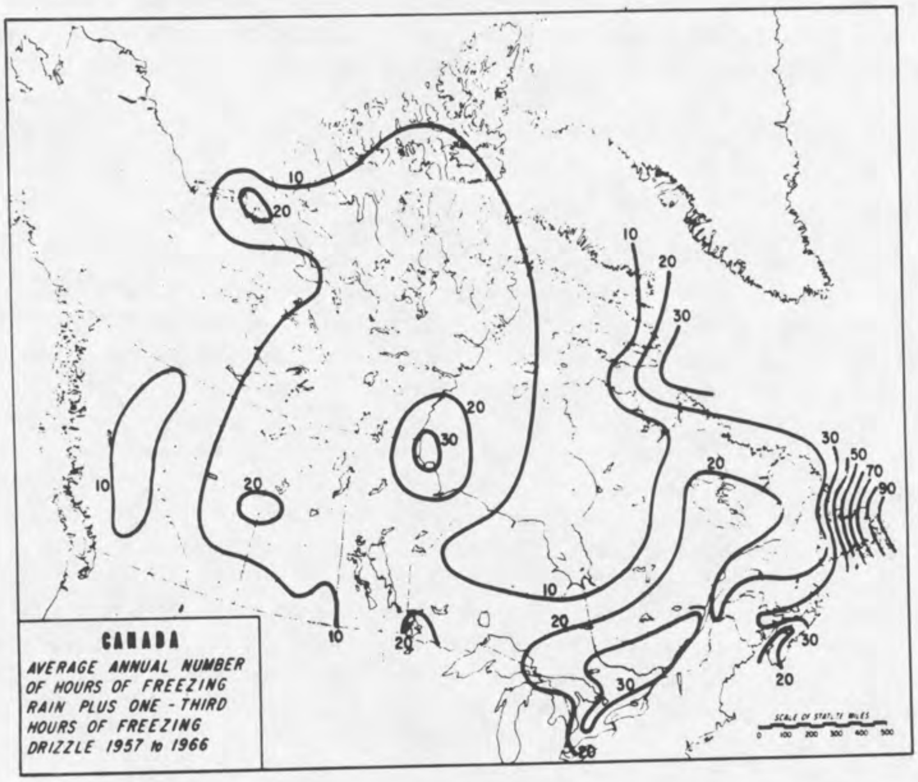


Figure 4. Index of severity of freezing precipitation.

DISCUSSION

This index of freezing precipitation seems to be compatible with the maps of reported ice thicknesses for the eastern half of Canada. In British Columbia, however, there have been a number of reports of severe icing but the freezing precipitation index is very low. There are two reasons for this:

High elevations are often within the clouds and when temperatures are below freezing icing usually occurs. It might be thought that conditions at high elevations would be of little interest because only the valleys are inhabited. In recent years, however, both power and communication structures have been erected at high elevations. The icing is usually rime. In the case of towers it will build up only on the windward side, as shown in Figure 3(d). These rime icing loads may be quite severe but they are not easily correlated with any of the weather observations at the valley stations.

The second reason for reports of severe icing in B.C. is heavy falls of wet snow sometimes followed by colder weather. Wet snow can occur anywhere in the country but it is usually accompanied by winds strong enough to blow any substantial accumulation of snow off the wires. In the well protected valleys of B.C. winds are particularly light and it seems that wet snow rather frequently accumulates to considerable depths on all kinds of wires. The snow loads are occasionally heavy enough to break the conductors.

No reports of icing have been received from the Yukon or Northwest Territories nor even from the northern halves of any of the provinces except the Maritimes. This may be the result of sparse population or poor communications rather than the absence of icing. In fact, the Arctic is notorious for winter fogs and many of these undoubtedly deposit rime.

CONCLUSION

The ice thicknesses summarized in the tables, the map based on an arbitrary assumption about the relative importance of freezing rain and freezing drizzle, and the lack of reports from the Territories and northern sections of most Provinces, all indicate that much more information is needed before design icing loads can be rationally and objectively assigned for any part of Canada.

In the meantime, however, structures sensitive to heavy icing loads will continue to be built and hence design loads must be estimated. It is believed that even the meagre data presented here can be used to improve the maps in the C.S.A. publications. The map in Figure 5 is offered as a basis for discussion.

The map divides the country into three zones on the basis of their supposed relative severity of icing loads. For design purposes actual loads must be assumed. The following table suggests appropriate ice thicknesses; the ice can be assumed to have a density of 0.9 gm/cm^3 or 57 lb/ft^3 .

Zone	On Wires, inches	On Towers, inches
I Light	0.25	0.5
II Medium	0.5	1.0
III Heavy	1.0	2.0

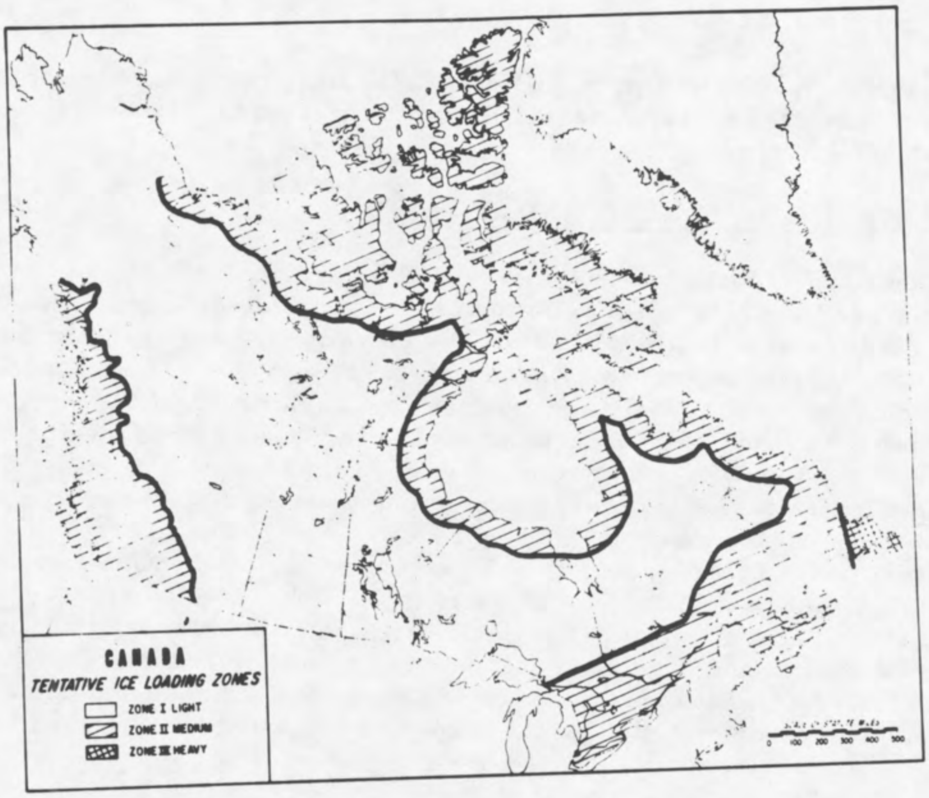


Figure 5. Tentative ice loading zones.

ACKNOWLEDGEMENT

The co-operation of the many companies and individuals who made this report possible by recording ice thicknesses is gratefully acknowledged. Special thanks are due to those who included photographs, a few of which are reproduced in Figure 3.

This paper is a contribution from the Division of Building Research, National Research Council of Canada, and the Meteorological Branch, Department of Transport, Canada, and is published with the approval of the Directors of the Division and the Branch.

REFERENCES

1. Canadian Standards Association. Canadian Electrical Code, Part 3, Outside Wiring Rules, C22.3 No. 1.5 - 1959, Heights of Conductors above Ground.

2. Canadian Standards Association. Antenna Towers and Antenna Supporting Structures, CSA Standard S37-1965.

3. McKay, G. A. and Thompson, H.A. Estimating the Hazard of Ice Accretion in Canada from Climatological Data. Jour. Appl. Meteor. Vol. 8, No. 6, p. 927-35, Dec. 1969.

EXPLANATION OF TABLES I AND II

The icing reports have been arranged by province and by date within each province. The locations are mostly the nearest populated places although other names have been used in a few cases. The elevations are those given in the icing reports when they were reported, but some have been taken from a catalogue of climatological stations. Some are averages. The duration of the icing storm in hours is tabulated under Hr. The accuracy of the larger values, which are multiples of 24, is of the order of half a day. The columns headed Wind and Wind Later indicate whether there were strong winds during the storm and after the storm. No means that the winds were not strong. The letter G indicates that the following value is the speed of peak gusts of wind, thus 40G55 means that the average wind speed was 40 mph with gusts to 55 mph. S&ZR in the Type column means snow and freezing rain. Ice thicknesses were usually reported in vulgar fractions of an inch and have been so tabulated whenever the ice was less than an inch thick. Greater thicknesses are tabulated in whole inches and decimal fractions. The reports plotted on the maps are indicated by asterisks (*).

TABLE I

ICING ON WIRES, BY PROVINCE

Prov.	Location	Elev., ft	Year	Date	Hr	Wind, mph	Wind Later, mph	Type	Thickness in.	Exposure
B.C. *	Langley	200	1935	Jan. 21	6	No	-	Glaze	2.5	Flat
*	Matsqui	30	1949	-	3	No	-	Glaze	1/2	Flat
	Vanderhoof	2100	1959	Dec.	48	No	-	Sleet	2.5	Sheltered
	Fort St. John	2200	1960	May 23	48	40	-	Snow	1.75	Flat
*	Terrace	300	1963	Dec. 21	24	No	-	Rime	2	Hilly
*	Alberni	1000	1964	Dec. 18	24	No	-	S&ZR	3	Mountain
*	Sandspit	60		Dec. 26	3	60	-	Glaze	1/2	Varied
*	Bella Coola	50		Dec. 31	18	5	-	S&ZR	1.5	Sheltered
	Terrace	700	1965	Dec. 3	11	G15	No	Snow	2	Benches
*	Courtenay	2000		Dec. 8	6	Yes	No	Rime	1.5	Mountain
	Campbell R.	Low		Dec. 24	24	15	No	Snow	2.5	Flat
	Sutton Pass	800		Dec. 27	4	No	No	Snow	5	Mountain
	Sunset Beach	400	1966	Jan. 4	-	No	No	Snow	2	Hilly
	L. Cowichan	800		Jan. 9	10	No	No	Snow	2	Hilly
*	Fraser Mtn.	3758		Feb. 1	144	20	30	Glaze	1/2	Plateau
	Mica Creek	1850		Dec. 16	48	No	No	Snow	1.25	Valley
*	Osoyoos	6100	1967	Mar. 21	41	19	15	Rime	1.5	Mountain
*	Clearwater	2500		Oct. 27	16	No	No	Rime	1.25	Hilly
	Alta Lake	2200		Oct. 27	-	Yes	Yes	Snow	4	Valley
	Pemberton	600		Oct. 27	-	Yes	Yes	Snow	4	Valley
*	Cheakamus	100	1968	Jan. 10	84	No	No	Rime	1	Valley
	Cheekye	50		Jan. 12	20	No	No	Rime	1/2	Delta
	Tisdall	1700		Jan. 18	31	No	No	Snow	4.5	Mountain
*	Kitimat	300		Jan. 19	7	-	-	Glaze	1/2	Mountain
ALTA. *	Calgary	3500	1965	Feb. 27	-	-	-	Glaze	1/4	-
*	Sedgewick	2300		May 16	9	40G55	Yes	S&ZR	1	-
*	Stettler	2700	1966	Mar. 13	72	No	No	Rime	1/4	Flat
	Stettler	2700		Apr. 11	48	No	-	Glaze	1/4	Flat
SASK. *	Lewvan	-	1965	Dec. 11	72	No	No	Rime	1.25	Flat
	North Portal	-		Dec. 11	10	No	No	Hoar	1.5	Flat
*	Regina	1885		Dec. 13	72	No	-	Rime	3/4	Flat
*	Central Butte	2065	1966	Mar. 10	-	-	-	Rime	3/4	Flat
MAN.	Deloraine	1640	1965	Dec. 11	72	No	No	Hoar	2	Flat
*	Minnedosa	1800	1967	Mar. 29	12	Yes	Yes	Glaze	1/2	Flat
ONT. *	White River	1243	1940	Dec. 9	4	Yes	No	Glaze	3/8	Exposed
*	Guelph	1100	1959	Feb. 14	48	No	No	Glaze	3/4	City
	Guelph	1100		Mar. 14	48	Yes	Yes	Glaze	1/4	City
	Guelph	1100		Dec. 28	72	Yes	Yes	Glaze	3/4	City
*	Marathon	1000	1964	Oct. 8	31	20	No	S&ZR	1	Low Flat
*	Haycroft	-		Dec. 4	7	Yes	No	Glaze	1/2	Flat
	Guelph	1100	1965	Feb. 10	48	No	No	Glaze	1/4	City
*	Millgrove	825		Feb. 25	18	20	40	Glaze	1/2	Flat
*	Bells Corners	250		Nov. 17	10	Yes	Yes	Glaze	3/8	Flat
*	Manotick	325		Nov. 17	10	Yes	Yes	Glaze	1/4	Flat
	Guelph	1100		Dec. 11	48	Yes	No	Glaze	1/4	City
*	Toronto	350		Dec. 11	20	No	-	Glaze	1/4	City
*	Milton	550		Dec. 12	16	No	Yes	Glaze	1/2	Hilly
*	Scarborough	514	1966	Mar. 12	14	No	No	Glaze	3/16	Nr. Bluff
*	St. Thomas	750		Apr. 27	-	-	-	Glaze	1/2	Flat
*	Ballantrae	-	1968	Jan. 14	28	Yes	Yes	Glaze	1/2	Rolling
*	Fenelon Falls	850	1969	Jan. 29	14	No	No	Glaze	3/8	Hilly

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TABLE I (cont'd)

ICING ON WIRES, BY PROVINCE

Prov.		Location	Elev., ft	Year	Date	Hr	Wind, mph	Wind Later, mph	Type	Thickness in.	Exposure
QUE.	*	Dorval	98	1965	Feb. 10	10	20G40	No	Glaze	3/8	Flat
	*	Lacolle	-		Feb. 10	2	Gusty	Gusty	Glaze	2	Flat
	*	St. Hilaire	125		Feb. 10	2	Yes	Yes	Glaze	1/4	Flat
	*	Bethanie	650		Feb. 25	1	75	-	-	1/4	Flat
	*	Joliette	108		Nov. 15	12	No	-	Rime	1/4	Flat
	*	Berthierville	-		Nov. 17	12	Yes	Yes	Glaze	1/2	Flat
	*	Hull	200		Nov. 27	12	Yes	Yes	Glaze	1/4	Flat
	*	Ste. Scholastique	225		Nov. 27	24	No	No	Glaze	1/2	Flat
	*	Ste. Therese	-		Nov. 27	8	Yes	Yes	Glaze	1/2	Flat
	*	Ste. Jean de Matha	-	1966	Mar. 5	2	Yes	Yes	Glaze	3/8	Hilly
	*	St. Calixte Nord	-		Mar. 6	8	No	No	Rime	1/2	Hilly
	*	Trois Rivieres		1967	Dec. 11	48	-	-	Glaze	1	-
		Anjou	-	1968	Nov. 28	17	10	No	Glaze	1/4	Flat
		Pont Viau	-		Nov. 28	14	35	5	Glaze	5/8	Flat
		St. Laurent	125		Nov. 28	12	20	No	Glaze	1/4	Flat
		St. Vincent de Paul	-		Nov. 28	15	No	No	Glaze	3/8	Flat
		St. Bruno	460		Dec. 23	8	30	15	Rime	1/2	Flat
	*	"Saguenay"	3000	1969	Nov. 13	192	Yes	-	Rime	3.5	Hilly
N. B.	*	Moncton	248	1964	Nov. 20	4	20	30	Glaze	3/8	Flat
		Moncton	248		Dec. 27	4	No	20G27	Glaze	1/4	Flat
	*	Spruce L.	MSL		Dec. 28	18	No	Yes	Glaze	3/8	Flat
	*	Baie Ste. Anne	150	1967	Dec. 4	12	No	No	Glaze	3/8	Flat
N. S.	*	Antigonish	30	1961	Mar.	168	-	-	Rime	4.25	-
	*	Cheticamp	1750	1964	Dec. 29	10	90	30	Glaze	2	Flat
		Antigonish	920	1965	Jan. 1	24	Yes	No	Glaze	1.5	Hilly
	*	Cape Mabou	1050		Jan. 2	7	35	20	Glaze	2	Flat
	*	Bay St. Lawrence	1250		Jan. 4	22	40	15	Glaze	2	Flat
	*	Whitehead	100	1966	Mar. 5	17	No	No	Glaze	1	Flat
	*	Port Hawkesbury	100		Mar. 5	16	-	No	Glaze	1	Hilly
		Port Hawkesbury	100	1968	Feb. 9	12	30	30	Rime	1/2	Coast
NFLD.		St. John's	125	1958	Feb. 27	46	-	-	Glaze	1	-
	*	Conception Bay	950	1964	Jan. 24	-	No	No	Glaze	5	Severe
	*	Twillingate	150	1965	Dec. 26	12	38-48	30-35	Glaze	1/4	Hilly
		Kenmount Hill	500	1966	Jan. 9	24	Yes	Yes	Rime	1/2	Hilltop
	*	White Bay	1600		Jan.	-	-	-	Rime	3	Hilltop
	*	Roddickton	500		Jan. 18	24	Yes	Yes	Rime	3/4	Plateau
	*	Kenmount Hill	600		Jan. 19	24	25	-	Rime	1.5	Hilltop

TABLE II

ICING ON STRUCTURES OTHER THAN WIRES, BY PROVINCE

Prov.	Location	Elev., ft	Year	Date	Hr	Wind, mph	Wind Later, mph	Type	Thickness in.	Exposure
B. C.	Fraser Mtn.	3758	1966	Feb. 1	144	20	30	Glaze	1/2	Plateau
*	Osoyoos	6100		Nov. 15	240	13	20	Rime	20	Mountain
	Osoyoos	6100	1967	Mar. 21	41	19	15	Rime	4	Mountain
*	Cheakamus	100	1968	Jan. 10	84	No	No	Rime	1	Valley
ALTA*	Sedgewick	2300	1965	May 16	9	40G55	Yes	S&ZR	6	-
ONT. *	Little Current	975	1954	Mar. 1	-	29	-	S&ZR	1.5	Hilly
	Guelph	1100	1959	Feb. 14	48	No	No	Glaze	3/4	City
	Guelph	1100		Mar. 14	48	Yes	Yes	Glaze	1/4	City
	Guelph	1100		Dec. 28	72	Yes	Yes	Glaze	3/4	City
	Guelph	1100	1965	Feb. 10	48	No	No	Glaze	1/4	City
	Millgrove	850		Feb. 25	18	20	40	Glaze	1/2	Flat
	Guelph	1100		Dec. 11	48	Yes	No	Glaze	1/4	City
	Toronto	400		Dec. 11	20	No	-	Glaze	1/4	City
	Milton	550		Dec. 12	16	No	Yes	Glaze	1/2	Hilly
	St. Thomas	750	1966	Apr. 27	-	-	-	Glaze	1/2	Flat
	North Bay	850		Nov. 3	8	30	-	Glaze	1/2	Flat
*	St. Thomas	750	1967	Jan. 27	-	60	-	Glaze	1.25	Flat
	Ballantrae	-	1968	Jan. 14	28	Yes	Yes	Glaze	1/2	Rolling
*	Leaside	-		Jan. 14	28	Yes	Yes	Glaze	2	Flat
QUE. *	St. Constant	100	1961	Feb. 25	-	G70	-	Glaze	2	Flat
	Dorval	98	1965	Feb. 10	10	20G40	No	Glaze	1/4	Flat
*	Lacolle	-		Feb. 10	2	Gusty	Gusty	Glaze	4	Flat
*	St. Scholastique	225		Nov. 27	24	No	No	Glaze	2.5	Flat
	Ste. Therese	150		Nov. 27	8	Yes	Yes	Glaze	1/2	Flat
	St. Vincent de P.	-	1968	Nov. 28	15	No	No	Glaze	3/4	Flat
	St. Bruno	460		Dec. 23	8	30	15	Rime	3/4	Flat
*	"Saguenay"	3000	1969	Nov. 13	192	Yes	-	Rime	8	Hilly
N. B. *	Caledonia Mtn.	1300	1956	Jan.	168	No	-	Glaze	5	Hilly
	Moncton	248	1964	Nov. 20	4	20	30	Glaze	3/8	Flat
	Moncton	248		Dec. 27	4	No	20G27	Glaze	1/4	Flat
N. S. *	Ecum Secum	100	1964	Mar. 27	-	Yes	-	Glaze	3	Hilly
	Halifax	461		Dec. 28	21	G25	G25	Glaze	1/2	Rolling
	Antigonish	920	1965	Jan. 1	24	Yes	No	Glaze	4	Hilly
*	Antigonish	1020		Jan. 3	-	No	-	Glaze	10	Hilly
	Brown's Mtn.	-		Jan. 5	-	G40	-	Glaze	10	Hilly
NFLD	St. John's	125	1958	Feb. 27	46	-	-	Glaze	1.25	-
	St. Lawrence	96	1962	Feb.	-	40	-	Glaze	3/4	-
*	Conception Bay	950	1964	Jan. 24	-	No	No	Glaze	8	Severe
*	Torbay	525		Feb.	-	G75	-	Glaze	12	Flat
*	Gander	488	1965	Jan. 2	38	No	No	Glaze	1.5	Flat
*	Lascie	330		Jan. 6	-	40	-	Glaze	15	Flat
*	Port aux Basque	185		Feb.	-	50	-	Glaze	1	Hilly
*	Cook's Harbour	450		Mar. 5	-	G105	-	Glaze	12	Hilly
	Kenmount Hill	500	1966	Jan. 9	24	Yes	Yes	Rime	1	Hilltop
*	White Bay	1600		Jan.	-	-	-	Rime	6	Hilltop
*	Gaff Topsails	1100		Jan. 13	48	40-50	No	Rime	2	Hillside
	Gaff Topsails	1100		Jan. 18	24	Yes	Yes	Rime	2	Hillside
	Kenmount Hill	600		Jan. 19	24	25	-	Rime	3	Hilltop
*	Heart's Cont't	900		Jan. 20	36	30-40	30-40	Glaze	6	Hilltop
	Gander	482	1967	Apr. 12	5	Yes	Yes	Glaze	1/4	Flat