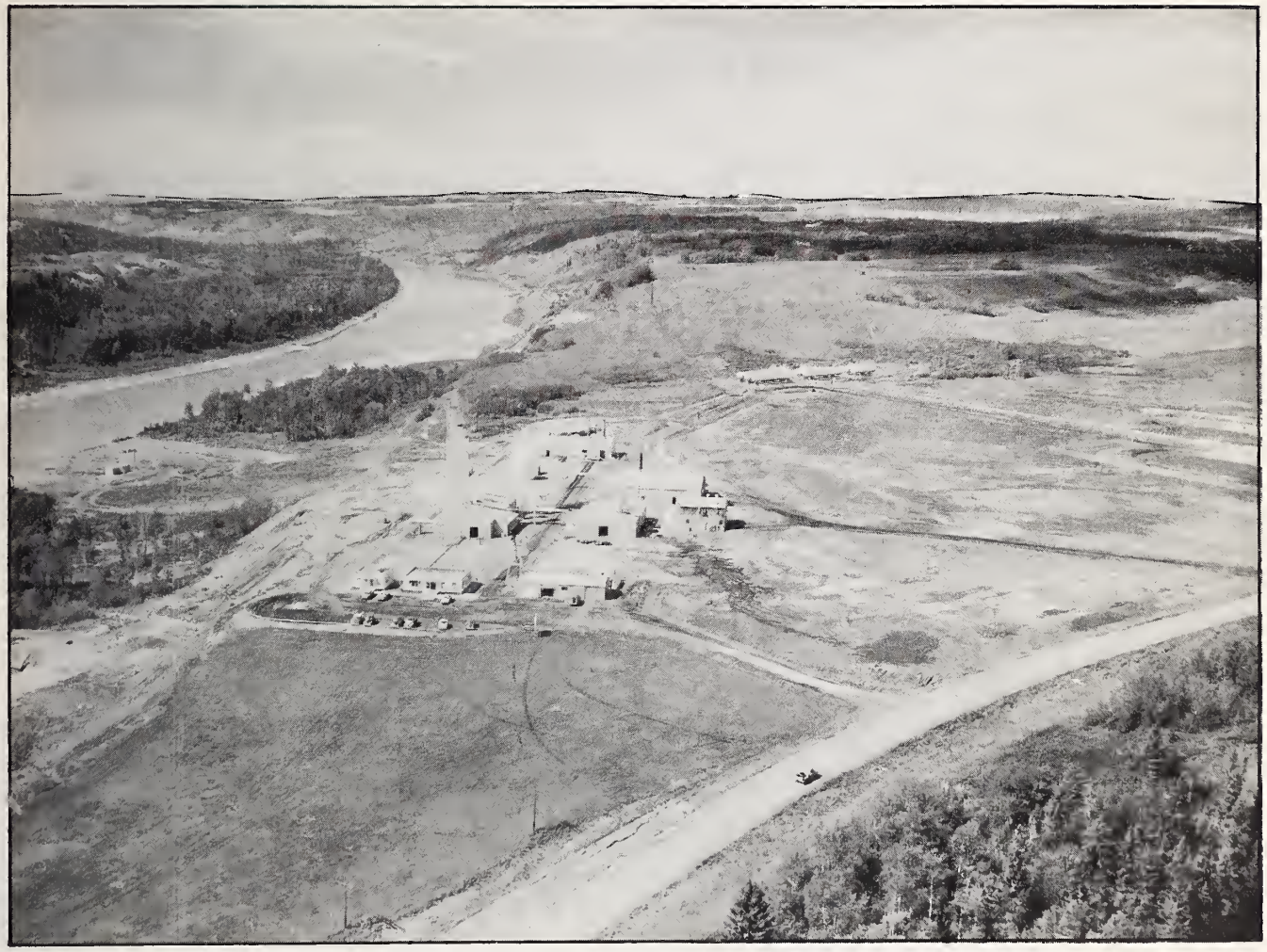
ALBERTA POWER COMMISSION



1959 ANNUAL REPORT

GOVERNMENT OF THE PROVINCE OF ALBERTA

ANNUAL REPORT

OF THE

ALBERTA POWER COMMISSION

FOR THE YEAR ENDING

DECEMBER 31, 1959

EDMONTON

J. G. MacGREGOR

CHAIRMAN

January 31st, 1960.

The Honorable A. Russell Patrick,
Minister of Industry and Development,
Legislative Building,
Edmonton, Alberta.

Sir:

I have the honor to submit herewith the Annual Report of the Alberta Power Commission for the calendar year ended December 31st, 1959.

An audited statement of receipts and disbursements of the Alberta Power Commission will be sent under separate cover.

Respectfully submitted,

ALBERTA POWER COMMISSION

J. G. MacGregor,
Chairman.

ALBERTA POWER COMMISSION

1959

J. G. MacGregor,
Chairman

J. E. Oberholtzer,
Member

W. C. Whittaker,
Member

J. L. Reid,
Member
and Secretary

COVER PHOTO

British American Oil Co. Ltd. Gas processing plant on the Red Deer River near Nevis.

Similar industries are coming into being in many parts of the Province.

Alberta Government Photograph

P R E F A C E

The Alberta Power Commission is not an operating Commission; that is, it does not own or operate any power plants, transmission lines or distribution systems. In this respect it is different from the Power Commissions in all the other Provinces, except Prince Edward Island and Newfoundland. Keeping this in mind, it might be well to consider the duties and the responsibilities of the Power Commission. Its duties at present, under the Power Commission Act, are only those of a regulatory or supervisory nature. These duties are largely covered by Section 6 of the Power Commission Act, which is as follows:

"Whenever required so to do by the Lieutenant Governor in Council the Commission shall inquire into, examine and investigate, -

(a) water powers and water privileges in Alberta, their value and capacity;

(b) the existing facilities for the manufacture and distribution of power in Alberta;

(c) such other matters relating to power and its distribution in Alberta as the Lieutenant Governor in Council from time to time may require;

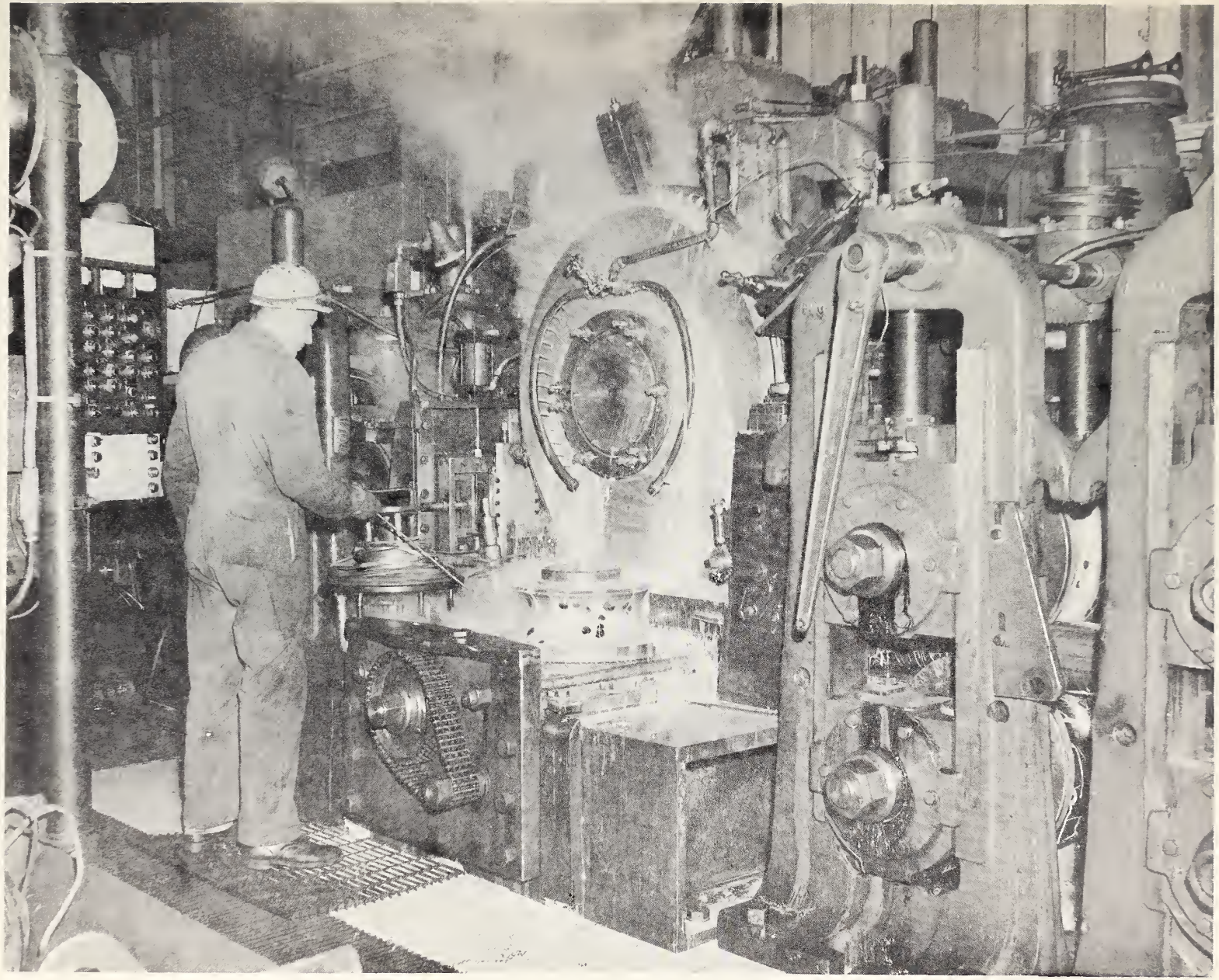
and shall report thereon to the Lieutenant Governor in Council".

The Commission feels that its principal duties at the present time are threefold:

1. The collection of statistics of the Central Station Industry in the Province, and the study of these statistics so that the people of the Province will have a true picture of the industry.
2. The study of hydro-electric sites and other power possibilities in the Province. During the past year there have been no direct studies of specific hydro-electric sites. The Commission, however, has been engaged

in a study of the existing network of transmission lines in the Province with particular reference to more extensive interconnection which will ensure the most efficient use of the large generating units which are already in operation and of those anticipated in the future.

3. Farm Electrification. This is a phase of its work to which the Commission has devoted much of its time. The main network of farm electrification lines is now practically completed. From here on, with very few exceptions, the additional farms to be electrified will be adjacent to existing lines. While the construction phase of farm electrification is almost over, problems of operating the farm lines are now taking much more time. The Commission is presently engaged in rather detailed studies of the deposit reserves of individual R.E.A.'s.



Alberta Government Photo

Electric Welder and Induction Normalizing Equipment in pipe manufacturing Industry. Alberta Phoenix Tube & Pipe Ltd. at Edmonton.

ALBERTA POWER COMMISSION

ANNUAL REPORT

For Year Ending December 31st, 1959.

The year 1959 was one of expansion and general prosperity in Alberta. Industry is becoming a much larger component of the Province's economy. During the year some 70 companies completed or started new plants or additions to existing plants. The approach of gas export has touched off announcements of construction or expansion of a series of refineries and gas processing plants now at various stages of development and worth more than $40,000,000.00.

Iron and steel and transportation industries are building plants and facilities worth $17,000,000.00 and for the first time in Western Canada two rubber tire plants with a total value of $11,500,000.00 are being built. Chemical and petrochemical plants worth another $30,000,000.00 are under way.

The year 1959 saw continued activity in the oil and gas well drilling program with more than 800 initial oil well completions and more than 200 gas well completions. About 9,250 oil wells and 780 gas wells are now capable of production.

The following comments provide a few figures for quick reference to indicate the remarkable growth of the Electric Utility Industry. The figures compiled in this report are confined to the Electric Utility Industry and are comparable to those compiled by the Dominion Bureau of Statistics under the category of "Utilities".

K.W.H. Generated. The increase in K.W.H. generated over that of the previous year was 14%. Thermal plants generated over 70% of the K.W.H. produced. Of this, internal combustion plants accounted for about the same proportion (2.2%) as they did during the previous year. This power, of course,

is mainly that generated by Northland Utilities Limited and Canadian Utilities Limited in the Peace River country and includes the power generated by the gas turbine at Valleyview. Canadian Utilities Limited operates a diesel plant in the Swan Hills oilfield where the load has been growing rapidly.

Peak Load. The increase in peak load for the Province has been 13% over that for the year 1958. The peak day occurred in November while December was a relatively mild month. Had the weather in December been normal a higher peak might have been expected. The following figures are an estimate of the actual coincident peak for the Province.

System	Estimated Peak Load K.W., 1959
Interconnected system, less East Kootenay Power Co. Ltd. and Northland Utilities Limited	629,000
East Kootenay Power Co. Ltd.	2,500
Canadian Utilities Ltd. (Peace River country)	8,818
(McMurray)	290
Northland Utilities Limited	10,927
	651,535
say,	652,000

Transmission lines in the Province increased by 622 miles to a total of 12,642, which includes 2,949 miles of Company-owned farm lines. Distribution line mileage increased 415 miles to 4,679. The total mileage of all farm lines increased by 2,644 miles, so that the total farm mileage at the end of 1959 was 37,996. The total mileage of all power lines in the Province at the end of December, 1959, was 52,368.

Tables No. 1 to 8 which follow provide the summary of the most recent statistics:

Table No. 1 shows the capacity in M.W. of the Utility Electric Stations in Canada for the past ten years.

TABLE NO. 1

Capacity of Utility Electric Stations
M.W.

Year	Alberta	Canada	Saskatchewan	Manitoba
1948	165	7,491	218	350
1949	207	7,939	232	350
1950	208	8,734	234	445
1951	280	9,724	272	457
1952	288	10,613	322	542
1953	372	11,687	347	561
1954	504	12,479	356	561
1955	477	13,422	394	637
1956	572	* 12,463	415	637
1957	596	13,444	452	644
1958	718	14,758	529	741
1959	750			

Increase during the 10 year period ended 1958

Year	Alberta	Canada	Saskatchewan	Manitoba
1958	718	14,758	529	741
1948	165	7,491	218	350
Increase:	553	7,267	311	391
Percent Increase:	335%	97%	143%	112%

Increase Alberta: 1949 to 1959 - 262%

* In 1956 the D.B.S. changed its classification of statistics from Central Stations to Utilities.

Except for Alberta the figures from 1948 to 1958 have been taken from D.B.S. publications. Alberta figures are those compiled by the Alberta Power Commission.

Table No. 2 shows the growth of K.W.H. generated net during the past ten years.

TABLE NO. 2

Electric Energy Generated by Utilities

(Millions of K.W.H.)

Year	Alberta	Canada	Saskatchewan	Manitoba
1948	724	42,390	805	2,056
1949	793	* 37,595	841	2,164
1950	857	41,431	888	2,453
1951	984	48,055	968	2,562
1952	1,146	51,841	1,068	2,696
1953	1,298	53,340	1,161	2,791
1954	1,485	55,334	1,280	2,937
1955	1,707	61,642	1,409	3,102
1956	1,996	68,845	1,537	3,331
1957	2,249	71,522	1,678	3,341
1958	2,474	75,953	1,809	3,214
1959	2,830			

Increase during the 10 year period ended 1958

Year	Alberta	Canada	Saskatchewan	Manitoba
1958	2,475	75,953	1,809	3,214
1948	724	42,390	805	2,056
Increase:	1,750	33,563	1,004	1,158
Percent Increase:	242%	79%	125%	56%

Increase Alberta: 1949 to 1959 - 257%

* This is due to a change in classification.

The figures from 1948 to 1958 have been taken from D.B.S. publications. 1959 figures for Alberta are those compiled by the Alberta Power Commission.

TABLE NO. 3

Annual K.W.H. used per Domestic and Farm Customer

Year	Alberta	Canada	Saskatchewan	Manitoba
1948	989	2,078	1,115	4,628
1949	1,073	2,168	1,199	4,694
1950	1,224	2,413	1,353	4,783
1951	1,384	2,617	1,531	4,813
1952	1,473	2,809	1,677	4,868
1953	1,624	3,008	1,878	4,960
1954	1,865	3,271	2,072	5,229
1955	1,975	3,500	2,483	5,420
1956	2,256	3,740	2,361	5,636
1957	2,373	3,960	2,577	5,895
1958	2,532	4,128	2,696	6,113

These are Dominion Bureau of Statistics figures.

Increase during the 10 year period ended 1958

Year	Alberta	Canada	Saskatchewan	Manitoba
1958	2,532	4,128	2,696	6,113
1948	989	2,078	1,115	4,628
Increase:	1,543	2,050	1,581	1,485
Percent increase:	156%	99%	142%	32%

Manitoba has an exceptionally high figure for K.W.H. used per domestic customer. This is partly due to the fact that one city alone - Winnipeg - contains a large percentage of the total population of the Province. It is also due to the fact that the cost of developing the water power sites adjacent to Winnipeg was possibly the cheapest in the world. This provided cheap power for the people of the City of Winnipeg, and since fuel was expensive there, electricity was used extensively for cooking and heating, and a happy combination of low rates produced high use, and vice versa.

The figures for Canada for K.W.H. used per year per domestic customer is high because it takes into account the high consumption in Manitoba and Ontario.

TABLE NO. 4

Costs in Cents per K.W.H. Domestic Customers Only

Year	Alberta	Canada	Saskatchewan	Manitoba
1948	3.72	1.60	4.09	1.06
1949	3.54	1.59	3.95	1.11
1950	3.28	1.61	3.80	1.15
1951	3.16	1.65	3.70	1.18
1952	3.06	1.65	3.59	1.21
1953	2.91	1.70	3.52	1.23
1954	2.75	1.69	3.39	1.25
1955	2.64	1.66	2.93	1.18
1956	2.51	1.64	3.17	1.15
1957	2.44	1.62	3.11	1.13
1958	2.40	1.61	3.08	1.06

These are Dominion Bureau of Statistics figures.

Decrease during the 10 year period ending 1958

Year	Alberta	Canada	Saskatchewan	Manitoba
1948	3.72	1.60	4.09	1.06
1958	2.40	1.61	3.08	1.06
Percent Decrease	36%	Increase 1%	Decrease 25%	Increase -

TABLE NO. 5

Total Number of Customers of Utilities
(Thousands)

Year	Alberta	Canada	Saskatchewan	Manitoba
1947	131	2,643	97	148
1948	142	2,822	106	151
1949	157	3,076	114	163
1950	172	3,270	121	179
1951	186	3,440	127	194
1952	200	3,621	139	209
1953	221	3,817	151	221
1954	239	4,002	170	234
1955	267	4,225	185	243
1956	276	4,412	206	254
1957	295	4,597	220	258
1958	* 311			
1959	* 336			

Increase during the 10 year period ending 1957

Year	Alberta	Canada	Saskatchewan	Manitoba
1957	295	4,597	220	258
1947	131	2,643	97	148
Increase:	164	1,954	123	110
Percent Increase:	125%	74%	127%	74%

*Figures marked thus are Alberta Power Commission figures, and others are from the Dominion Bureau of Statistics

TABLE NO. 6

Number of Farms Served by Utilities
as at December 31 each year

Year	* Alberta	Saskatchewan	Manitoba
1949	5,017	2,299	11,155
1950	11,032	4,057	16,964
1951	13,479	5,594	23,777
1952	18,055	8,591	29,623
1953	24,181	13,850	33,601
1954	30,504	21,287	37,422
1955	34,768	28,993	38,277
1956	37,658	38,495	38,091
1957	41,130	44,955	38,120
1958	45,848	* 51,500	* 42,000
1959	49,923		

TABLE NO. 7

Consumption in K.W.H. per Farm per Year

Year	Alberta	Canada	Saskatchewan	Manitoba
1948	1,883	1,711	860	1,940
1949	2,128	1,752	880	2,113
1950	2,250	1,932	880	2,359
1951	2,461	2,085	1,266	2,475
1952	2,747	2,228	1,527	2,666
1953	2,604	2,420	1,915	2,943
1954	2,958	2,672	2,053	3,541
1955	* 2,892	2,803	2,054	3,564
1956	* 3,040	3,060	2,217	3,911
1957	* 3,564	3,415	2,490	4,238
1958	* 3,530			
1959	* 3,979			

* Figures marked thus are Alberta Power Commission figures, and others are from the Dominion Bureau of Statistics.

TABLE NO. 8

Total Pole Line Mileage
(Includes transmission, distribution and rural lines)

Year	Alberta	Canada	Saskatchewan	Manitoba
1948	7,552	113,411	5,009	11,564
1949	10,103	135,329	5,371	16,785
1950	12,108	151,726	5,712	20,472
1951	15,125	170,582	9,574	24,439
1952	20,188	190,316	13,858	28,514
1953	26,211	213,176	20,899	32,237
1954	* 31,736	228,158	26,177	33,615
1955	* 36,233	243,773	33,755	33,219
1956	* 39,430	265,389	44,516	34,232
1957	* 43,404	285,306	54,700	34,317
1958	* 48,721			
1959	* 52,368			

* Figures marked thus are Alberta Power Commission figures, the others are from the Dominion Bureau of Statistics.

TABLE NO. 9

K.W.H. Generated per Capita in Alberta.

Year	Population	K.W.H. Generated x 10^6	K.W.H. Generated/Capita
1948	854,000	724	848
1949	885,000	801	905
1950	913,000	869	952
1951	939,000	1,055	1,123
1952	970,000	1,213	1,250
1953	1,002,000	1,341	1,338
1954	1,039,000	1,499	1,443
1955	1,066,000	1,728	1,621
1956	1,123,000	2,019	1,798
1957	1,160,000	2,243	1,934
1958	1,201,000	2,474	2,060
1959	1,243,000	2,830	2,277

Nitro-chemical Industry at Medicine Hat

Alberta Government Photo

PRESENT STATUS OF THE INDUSTRY

The Statistics for the Electric Utilities for the year 1959 follow: Some of the minor figures are estimates only due to the fact that the report has to be prepared before the various utilities have completed their statistics for the past year. These minor estimates will not be in error by more than 1% or 2%, so that the error in the whole will be negligible. Wherever we have estimated a figure it is marked "est".

Tables 10 to 13 deal with plant capacity, peak load, and K.W.H. generated. They break up the figures to show what was generated by hydro, steam and internal combustion engines, and also to show the proportions generated by the publicly owned and the privately owned plants. Table No. 13 gives further details of the generating plants and their output. It will be noted that it is divided into three groups, A., B., and C.

The largest, Group A., contains those power plants which are connected by transmission lines, so that we speak of them as being in the interconnected system. This group which covers most of the Province includes towns served by Calgary Power Ltd., Canadian Utilities, Limited (excluding areas shown under B. and C.), the Athabasca system of Northland Utilities Limited, the cities of Edmonton, Calgary, Red Deer and Medicine Hat, and the Towns of Ponoka, Fort Macleod and Cardston. Some of these do not generate their own power but purchase it from Calgary Power Ltd., and retail it to their inhabitants.

Group B. takes in the Peace River country and includes the territory served by Canadian Utilities, Limited and Northland Utilities Limited. The systems of these companies are tied together by transmission lines from Fairview to Rycroft and from Valleyview to High Prairie, so that now the whole of the Peace River country is one interconnected system.

Group C. includes various isolated towns served either by Northland Utilities Limited or by Canadian Utilities, Limited.

In 1959 the interconnected system shown as Group A. had a combined capacity of 718,100 K.W., and generated 2,763,057,000 K.W.H. It served 321,553 customers. This system accounts for 96% of the generating capacity of the Province, 98% of the K.W.H. generated, and 96% of the number of customers.

The Peace River country interconnected system shown as Group B. had a combined capacity of 24,250 K.W. and generated 56,171,000 K.W.H. and served 13,158 customers.

TABLE NO. 10

The following Companies or Municipalities provide Central Station Electrical Service in the Province. This table gives preliminary data as to their plant capacity, their loads, and the K.W.H. they generated net in 1959.

Privately Owned

Name of Company	Plant Capacity Dec. 31/59 K.W.	Peak Load (KW) on plants during 1959	K.W.H. Gen. Net - 1959 (thousands)
1.			
Calgary Power Ltd.	384,000	372,000	1,599,541
Canadian Utilities Ltd.	87,065 (1)	68,200	252,234 (2)
Northland Utilities Ltd.	14,135	9,165	25,452
East Kootenay Power Co. Ltd.(3)	12,500	5,100	180
1. Total:	497,700		1,877,407

Publicly Owned

Name of Municipality			
2.			
City of Edmonton	185,000	148,000	590,220
City of Lethbridge	23,500	15,000	61,263
City of Medicine Hat	43,400	41,500	300,669 (4)
2. Total:	251,900		952,152
Plus 1. Total:	497,700		1,877,407
GRAND TOTAL:	749,600		2,829,559

(1) Includes one 1,200 K.W. unit at Fairview.

(2) Includes some K.W.H. generated at Fairview.

(3) The East Kootenay Power plant is located at Sentinel some two or three miles inside the Alberta border. While this energy is generated in Alberta, most of it is exported to British Columbia.

(4) Includes 224,633,900 K.W.H. sold to Calgary Power Ltd.

TABLE NO. 11

It is interesting to rearrange the figures of Table No. 10 so as to list them according to whether the power was generated by hydro, steam or internal combustion plants.

HYDRO

Name of Company	Plant Capacity Dec. 31/59 K.W.	Peak Load (KW) on plants during 1959	K.W.H. Gen. Net - 1959 (thousands)
Calgary Power Ltd.	240,000	231,000	837,280
Northland Utilities Ltd.	1,600	500	4,452
Total Hydro	241,600		841,732
STEAM			
Calgary Power Ltd.	144,000	142,000	762,247
Canadian Utilities Ltd. (5)	68,500	57,300	210,210
East Kootenay Power Co. Ltd. (1)	12,500	5,100	180
City of Edmonton (7)	185,000	148,000	590,220
City of Lethbridge (7)	23,500	15,000	61,263
City of Medicine Hat	43,400	41,500	300,669 (2)
Total Steam:	476,900		1,924,789
INTERNAL COMBUSTION			
Calgary Power Ltd.			14
Canadian Utilities Ltd. (6)	18,565 (3)	10,900	42,024
Northland Utilities Ltd.	12,535	8,665	21,000
Total Internal Combustion:	31,100		63,038
GRAND TOTAL:	749,600		2,829,559

(1) See footnote (3) on Table No. 10.

(2) Includes 224,633,900 K.W.H. sold to Calgary Power Ltd.

(3) Includes 1,200 K.W. unit at Fairview.

(4) Includes some K.W.H. generated at Fairview.

(5) Includes Gas Turbine - Vermilion.

(6) Includes Gas Turbine - Valleyview.

(7) Includes Gas Turbine.

TABLE NO. 12

The following table may be of interest as showing the relative position of steam, hydro and internal combustion in the Province, December 31, 1959.

Method of Generation	% of Power Generated	% of Capacity
Hydro	29.8	32.3
Steam & Gas Turbine	68.0	63.6
Internal Combustion	2.2	4.1
	100	100
Publicly owned	33.7	33.6
Privately owned	66.3	66.4
	100	100

TABLE NO. 13

SUMMARY OF GENERATING PLANTS IN ALBERTA

AS AT DECEMBER 31, 1959

Owner	Hydro		Steam		Internal Combustion	
	K.W. Rating	K.W.H. generated, 1959 (thousands)	K.W. Rating	K.W.H. generated, 1959 (thousands)	K.W. Rating	K.W.H. generated, 1959 (thousands)
A. Within the interconnected system						
Calgary Power Ltd. (only)	240,000	837,280	144,000	762,247		14
Canadian Utilities Ltd.			68,500 (1)	210,210 (1)		
East Kootenay Power Co. Ltd.			12,500	180		
City of Edmonton			185,000 (1)	590,220 (1)		
City of Lethbridge			23,500 (1)	61,263 (1)		
Athabasca System (N.U.L.)					1,200	974
City of Medicine Hat			43,400	300,669		
TOTAL GROUP A:	240,000	837,280	476,900	1,924,789	1,200	988
B. Peace River Interconnected System						
Canadian Utilities Ltd.					17,000 (1)	39,941 (1)
Northland Utilities Ltd.					7,250	16,230
TOTAL GROUP B:					24,250	56,171
C. Isolated Systems						
Northland Utilities Ltd.						
Jasper	1,600	4,452			2,225	1,782
Lac La Biche					1,275	1,686
Ft. Vermilion					340	231
Wabasca					190	92
High Level					55	5
Canadian Utilities Ltd.						
Fort Chipewyan					150	49
McMurray					525	1,126
Smith					425	221
Swan Hills					465	687
TOTAL GROUP C:	1,600	4,452			5,650	5,879
TOTAL ALL GROUPS:	241,600	841,732	476,900	1,924,789	31,100	63,038
GRAND TOTAL:	749,600	2,829,559				

(1) Includes gas turbines.

TABLE NO. 14

Total Circuit Miles of Transmission Lines in the Province by Regional Groups as at December 31, 1959. This includes Company-owned Farm Lines, but does not include the Co-operative-owned Farm Lines.

	VOLTAGE				
	2,300 to 22,000 V.	33,000 V.	50,000 to 72,000 V.	132,000 V & greater	Total
A. Within the Interconnected System					
Calgary Power Ltd.	6,748	29	1,117	1,088	8,982
Canadian Utilities Ltd.	1,665	225	523	143	2,556
City of Medicine Hat	30				30
East Kootenay Power Co. Ltd.	26		48		74
Athabasca System	50				50
Total Group A.	8,519	254	1,688	1,231	11,692
B. Systems within the Peace River Country					
Canadian Utilities Ltd.	320	30	149		499
Northland Utilities Ltd.	305		98		403
Total Group B.	625	30	247		902
C. Isolated Towns					
Northland Utilities Ltd.					
Jasper	27				27
Lac La Biche	15				15
Canadian Utilities Ltd.					
McMurray	6				6
Total Group C.	48				48
TOTAL ALL GROUPS	9,192	284	1,935	1,231	12,642

TABLE NO. 15

SUMMARY OF DISTRIBUTION SYSTEMS IN ALBERTA

As at December 31, 1959

	Total Number of Customers Served (Includes Rurals)	K.W.H. Sold (Less Sales to other Co's) (thousands) (Includes Rurals)	Circuit Miles of Line (Excludes Rurals)
A. Within the Interconnected System			
Calgary Power Ltd.	106,000	1,010,000	1,677
Canadian Utilities Ltd.	35,062	167,378	592
East Kootenay Power Co. Ltd. (1)	1,067	5,636	24
City of Edmonton	76,350	521,700	768
City of Calgary	76,000 (Est.)	544,000 (Est.)	800 (Est.)
City of Lethbridge	10,642	53,289	121
City of Medicine Hat	7,250 (Est.)	71,700 (Est.)	130 (Est.)
City of Red Deer	4,919	26,170	91
Town of Cardston	917	2,993	30
Town of Fort MacLeod	868	2,433	20
Town of Ponoka	1,335	4,999	25
Athabasca System	1,143	2,685	37
TOTAL GROUP A:	321,553	2,412,983	4,315
B. Systems Within the Peace River			
Canadian Utilities Ltd.	6,876	27,379	146
Northland Utilities Ltd., including High Prairie, McLennan, Valleyview and Manning	6,282	18,180	135
TOTAL GROUP B:	13,158	45,559	281
C. Isolated Towns			
Northland Utilities Ltd.			
Jasper	706	5,923	24
Lac La Biche	427	1,460	11
Fort Vermilion	75	198	5
Wabasca	10	91	6
High Level	8	4	2
Canadian Utilities Ltd.			
Fort Chipewyan	22	9	2
McMurray	331	1,053	10
Smith	76	200	2
Swan Hills	74	488	21
TOTAL GROUP C.	1,729	9,426	83
G R A N D T O T A L :	336,440	2,467,968	4,679

(1) Includes Towns of Coleman, Frank, Cowley, etc.

TABLE NO. 16

SUMMARY OF RURAL ELECTRIFICATION SYSTEMS IN ALBERTA
As at December 31, 1959.

	Number Farmers Served	Number Non-Farmers Served	Total Number Customers	Circuit Miles of Line
A. Within the Interconnected System				
Calgary Power Ltd.				
Experimental Areas and Individual Rurals (1)	4,075	867	4,942	2,400
R.E.A.'s	30,943	5,523	36,466	22,646
Canadian Utilities Limited				
Experimental Areas and Individual Rurals (1)	770	110	880	390
R.E.A.'s	9,842	826	10,668	8,864
Northland Utilities Limited - Athabasca System				
Experimental Areas and Individual Rurals (1)	3		3	2
R.E.A.'s	543	14	557	435
East Kootenay Power Co. Ltd.				
R.E.A.'s and Lundbreck Co-op.	132	51	183	140
Adjacent to Cities, etc. (1)	219		219	92
Total Group A.	46,527	7,391	53,918	34,969
B. Peace River Country				
Canadian Utilities Limited				
Experimental Areas and Individual Rurals (1)	69	99	168	40
R.E.A.'s	1,702	97	1,799	1,468
Northland Utilities Limited				
Experimental Areas and Individual Rurals (1)	125		125	24
R.E.A.'s	1,455	44	1,499	1,423
Total Group B.	3,351	240	3,591	2,955
C. Isolated Towns Served by Northland Utilities Limited				
Company-owned Rurals (1)	1		1	1
R.E.A.'s	44	18	62	71
Total Group C.	45	18	63	72
GRAND TOTAL :	49,923	7,649	57,572	37,996

(1) The lines to serve these farms are the property of the Power Companies. This mileage is also included in the table showing transmission lines under the heading of 2,300 to 22,000 volt lines, etc.

TABLE NO. 17

DATA RE CENTRAL STATIONS IN ALBERTA BY REGIONAL GROUPS
As at December 31, 1959

	Group A	Group B	Group C	Total
Plants				
K.W. Rating	718,100	24,250	7,250	749,600
K.W.H. Generated (thousands)	2,763,057	56,171	10,331	2,829,559
Transmission				
Miles of Line	11,692	902	48	12,642
Distribution				
Number of customers	321,553	13,158	1,729	336,440
K.W.H. sold (thousands)	2,412,983	45,559	9,426	2,467,968
Miles of line	4,315	281	83	4,679
Rural				
Number of farms (1)	46,527	3,351	45	49,923
Number of non-farms (1)	7,391	240	18	7,649
Miles of farm line (2)	34,969	2,955	72	37,996
Miles of R.E.A. line(3)	32,085	2,891	71	35,047

(1) Included in Number of Customers shown under Distribution.

(2) Partly included in Number of Transmission Lines.

(3) Not included in Miles of Line shown under Distribution or Transmission Lines.

The following is a more detailed summary of the additions to generating capacity, transmission line facilities, etc., during the year 1959.

Calgary Power Ltd.

(1) Changes in Plant Capacity

During 1959 work on the extensions to the Spray and Rundle Plants was resumed. These extensions will add a 50,000 kilowatt unit to the Spray Plant and a 30,000 kilowatt unit to the Rundle Plant. These units are scheduled for operation in the fall of 1960.

Work will begin in 1960 on the addition of a 150,000 K.W. unit to the Wabamun Steam Plant. This unit is scheduled for operation in the fall of 1962.

(2) Additional Transmission Lines

During the year 1959, Calgary Power Ltd. built the following transmission lines:

Edmonton	69 KV	Approximately 1 mile of circuit for interconnection between Edmonton Ring Main and the Line 65L.
Calgary to Okotoks	69 KV	Approximately 20 miles of line rebuilt. Original installation - 1926.
Foothills R.E.A. Sub. to Simons Valley	23 KV	Approximately 5 miles of old 2L rebuilt for 23 KV. Original installation about 1911.
Bickerdike to Obed	138 KV	25.78 miles - Presently operating 23 KV.
Hardisty	69 KV	69 KV circuit installed.
Irma to Hardisty	138 KV	17 miles - Operates at 69 KV.
100L to Gleichen	138 KV	17.4 miles.

80L to 12L near Lacombe	138 KV	6.17 miles.
Entwistle	69 KV	4 miles
Pembina Oil Field	23 KV 69 KV	9.75 miles circuit added 6.0 miles circuit added
146L to 42L - Glenwood	69 KV	15.37 miles

New substations were established at the following locations:

Sedgewick - 6,000 KVA, 69/23.9 KV. This substation obtains power from the Canadian Utilities Limited Battle River - Vermilion line and feeds the area in the vicinity of Sedgewick previously supplied from Camrose.

Hughenden - 6,000 KVA, 69/23.9 KV, picking up load previously fed from Wainwright substation.

Gleichen - 3,000 KVA, 138/23.9 KV, picking up load previously carried from the Rockyford substation.

Irricana - 2,000 KVA, 69/23.9 KV, picking up load previously fed from Airdrie.

Glenwood - 2,500 KVA, 69/23.9 KV, picking up load previously fed from Fort Macleod.

Lodgepole - 10,000 KVA, 69/23.9 KV, picking up part of the Pembina oil field load previously carried from the Drayton Valley substation.

Mayerthorpe - 2,500 KVA, 69/23.9 KV, picking up load previously fed from the Evansburg substation.

Extensions or additions to existing substations include the following:

Brooks substation - transformer capacity increased from 2,500 KVA to 6,000 KVA.

East Edmonton substation - 138/23.9 KV transformer capacity increased from 24,000 KVA to 37,000 KVA by removing a 12,000 KVA unit and installing a 25,000 KVA unit. Switching for additional two 23.9 KV circuits was also added.

Airdrie substation - transformer capacity was reduced from 6,000 KVA to 4,000 KVA.

Evansburg substation - transformer capacity was reduced from 2,500 KVA to 750 KVA.

Taber substation - transformer capacity was increased from 2,500 KVA to 6,000 KVA.

Vauxhall substation - this substation was rebuilt from 2,300 V secondary to 23.9 KV secondary and the transformer capacity increased from 1,000 KVA to 2,000 KVA.

Bearspaw substation - a 2,500 KVA, 23.9/13.2 KV transformer was installed to provide a source of 23.9 KV power for the area north of Bearspaw including the Provincial Jail.

East Calgary substation - a 10,000 RKVA static capacitor installation was completed to assist in maintaining adequate voltage and the supply of reactive for the City of Calgary load.

Drayton Valley substation - two 69 KV OCB's were installed for switching the two lines from this station to the Wabamun Plant.

(3) During the year the following Towns, Villages and Hamlets were added to the system of Calgary Power Ltd.

Hamlets:
- Bailey Subdivision
- Birch Bay
- Fisher Home
- Royal View Subdivision
- Saddle & Sirloin
- McKenzie Subdivision
- Valleyview Subdivision

(4) Service to Oilfields, New Industries, etc.

During 1959 Calgary Power Ltd. connected over 500 additional oil well pump services, about 60 battery pumping services and nearly 40 battery lighting services. In addition, a number of services were connected for other oilfield uses, being mainly for secondary recovery purposes and totalling 1,500 H.P. connected. New oilfields served during the year were Okotoks, Garrington, Gabriel Lake and Glen Park, although the majority of the new load was in the Pembina oilfield.

There was an increase in the crude oil marketing during 1959 which accounted for some of the increase in the oil industry load, with secondary recovery methods being a significant new load in some of the oilfields. 5,000 H.P. in pump units was added in a main crude oil pipeline station, and construction requirements were provided to a refinery site, with an ultimate load in 1960 of 1,200 H.P.

Increased activity was noted in the gas processing field. An additional 1,500 H.P. is now being supplied for the enlarged Pincher Creek plant of British-American, and service was provided three other gas processing plants totalling over 1,000 H.P.

In the latter part of 1959 an increasing trend was indicated in the coal mining load.

New services were provided during the year to a trailer manufacturing plant, saw and planing mills, radio station, about nine feed processing plants and other small industries. There were significant increases in consumption by a polythene plant and steel mill plant. Arrangements were made to supply a new fibre glass plant, pipe mill, sand and gravel plants, and further increases in load at a cement plant, which will be in operation next year.

The industrial component of Calgary Power's load is now showing a good increasing trend.

Canadian Utilities Limited

(1) Changes in Plant Capacity

The Company acquired the historical community of Ft. Chipewyan in 1959 and brought in 150 K.W. in diesel units to supply this rapidly growing center, which is the most northerly electrified community in Alberta.

Additional diesel units were brought into the Swan Hills Oil development even as the new transmission line to serve this area neared completion at year-end.

A new lumber mill at Smith was supplied with power from a 350 K.W. diesel unit connected in December.

(2) Transmission lines and substations worth $900,000 were completed in 1959; and co-ordination of all protective fuses, oil circuit breakers, and oil circuit reclosers on main-transmission and sub-transmission line networks was completed.

(a) Transmission Lines.

87 miles of 69 K.V. line from Willingdon to Bonnyville.

11 miles of 69 K.V. line from Diplomat Mine Sub. to Heisler.

25 miles of 69 K.V. line from Sturgeon plant toward Sarah Lake. (Through completely undeveloped timber and muskeg country).

10 miles of 23.9 K.V. line from Swan Hills to Sarah Lake.

8 miles of 23.9 K.V. line from Sandy Beach to Lloydminster. (Serving water wells supplying Lloydminster).

5 miles of 23.9 K.V. line from Elk Point to Lindberg. (Supplying community of Lindberg and surrounding R.E.A.'s which had previously been served from the Lindberg Salt Plant).

(b) Substations.

69 K.V. Oil Circuit Breaker at Vermilion substation.

Four 69 K.V. Circuit Breakers at Bonnyville switching station.

1,500 K.V.A., 23.9 K.V./4,160 substation at Grande Prairie.

3,000 K.V.A., 72/24.9 K.V. substation at Heisler.

1,500 K.V.A., 69 K.V./4,160 substation at Cold Lake for the Airport.

(3) Towns and Villages added to the Company's system in 1959

Fort Chipewyan
Beaver Dam

(4) Service to Oilfields, New Industries, etc.

Oilfield developments in the Swan Hills - Kaybob area in the north and in the Cessford and Choice fields in the south continued at a rapid pace.

New industries connected in 1959 included the oil well mud plant at

Rosalind; a lumber plant at Grande Prairie; communication towers; rectifiers for cathodic protection of pipelines; an extension at Nevis gas plant; and various gas and oil gathering stations.

An agreement was reached with Cities Service Research Company whereby Canadian Utilities, Limited leased a 700 K.W. diesel plant to them for use in the Athabasca Tar-sands research project.

City of Edmonton

Changes in Plant Capacity

During the year the second 30,000 K.W. gas turbine in the city's plant was commissioned. A similar unit was put on the line during 1958. These units are the largest gas turbines installed anywhere in the world. While there are other similar units being installed elsewhere in Canada, Edmonton's units will generate the highest electrical load. As the temperature decreases gas turbines can be operated at higher loads. For this reason these units will be operated at a higher load than similar turbines anywhere else in the world.

During 1959 good progress was made towards the installation of a 75,000 K.W. steam turbine which is expected to be commissioned in 1960.

In general considerable substation and transmission capacity has been added during the year to keep pace with the remarkable growth of load in the interconnected system. Considerable growth has taken place, also, in the oil fields in the general region of the Swan Hills where more wells are being brought in and this has resulted in an increased demand for power in the area north and west of the Athabasca River. At the moment this is being met by diesel generating plants but a transmission line is being built east from Canadian Utilities, Limited Valleyview plant to the Swan Hills townsite.

This will also serve part of the Judy Creek and adjacent fields. Electrical service will soon be needed in the Simonette field (Twp. 63-25-W.5th) and in the Berland River field (Twp. 58-23-W.5th). It is expected that the later will be served from the direction of the Windfall field, which in turn will be supplied by a heavy line running some thirty miles north from Edson. This line will be a main link in the ring taking in Edson, Windfall, Whitecourt and Wabamun. Fed off this ring will be the oil field north and east of Whitecourt, as well as some light loads along the highway north and west of that village.

From its Valleyview plant Canadian Utilities, Limited supply some light loads for some 60 miles south and east along the highway, so that there the gap between the two companies is gradually closing. The result is that the Peace River system, fed in part by the Valleyview plant, will be coming into contact with lines from the main interconnected system at Judy Creek and near Fox Creek. These lines are very light and are not capable of transferring power between the two interconnected systems. This condition will probably continue to exist for a number of years because the load in the Peace River country is not large enough to warrant building a transmission line with enough capacity to feed power into the Peace River area.

As the load in the Peace River area grows the following three sources of power all present possibilities;

1. A central thermal plant.
2. Power from Wabamun, etc.
3. Power from the Peace River Power Development Company Limited at Hudson Hope.

Of these three the last seems to be most likely at the moment. Once the Peace River Power Development is completed and loaded there should be

some cheap power available. If all of the power used in the Alberta portion of the Peace River country, however, were to be drawn from this source it would amount to one-half of one percent of the output of that plant. The unit cost of transmitting this small amount of power will be high so that it will probably have little effect in reducing the cost of power in that area. There has been some discussion about building a larger line to send power into the Edmonton area from Hudson Hope, but it is doubtful if this would be economical.

Alberta is so richly endowed with energy resources from which we can produce cheap power that, costwise, except for local areas, imported power cannot compete.

As well as having over two million H.P. of undeveloped hydro power, Alberta, with its oil, gas, tar sands and coal, has some 80% of all of Canada's known fossil fuels.

A popular fallacy is that hydro power is always cheaper than thermal. In Alberta this is not so. By far the cheapest power in Alberta today is that which we get from the Wabamun gas-fired steam plant. In 1962 that plant will switch over to using coal as fuel and will then produce power even more cheaply than it does now.

Because of the nature of Alberta's fuel resources, the ideal arrangement would be to generate some 94% of the K.W.H. needed in the Province in steam plants, leaving the remaining 6% to be generated by hydro plants. The peak load in the Province during 1959 was 652,000 K.W. Since the capacity to supply much of this load is only needed for such short intervals of time, the hydro plants, generally speaking, are well suited to perform this function. Hydro plants representing about 40% of the generating capacity of the Province would be required to carry the necessary portion of the peak load and in doing so would generate approximately 6% of the K.W.H.

Peak load is a major headache for all power companies. All together the capacity of Alberta's power plants is some 750,000 K.W. Now, if we look back at the load which we had on these plants during 1959, the situation is approximately the following:

2% of this, or 15,000 K.W., was used for 1 hour only in November.

4% of this, or 30,000 K.W., was used for only 2 hours in November.

10% of this, or 75,000 K.W., was used for only 11 hours.

20% of this, or 150,000 K.W., was used for only 204 hours spread over November, December, January, February and March.

That is, 150,000 K.W., or 20% of our capacity was used for only slightly over 2% of all the hours in the year, and in doing so only generated 2/10 of 1% of all the K.W.H. used in the Province.

Now, because 20% of our installed capacity is only called into use for 2% of the time in any one year and that then it only generates 2/10 of 1% of the year's power, we find it economical to use our Alberta rivers for producing this kind of peak power. As compared to the rivers in Manitoba, Ontario and Quebec and those in British Columbia, the flow of our rivers does not lend itself to producing power which we need 24 hours a day and 365 days in the year. The reason is that nearly all the water comes rushing down from the mountains during May and June and then for the rest of the year the rivers are almost dry. Our greatest demand for power does not occur during these months of early summer so our hydro plants and dams are built so as to store the summer water for use during the peak load periods of the winter.

There are sites for more hydro plants on the Bow River and of these the Russell Site immediately upstream from the Ghost River plant will probably have priority. In addition to these, the site on the Brazeau River which has been studied most intensively recently looks most promising. The

generating equipment in either of these proposed plants will be used solely to provide power for peaking purposes. The ultimate capacity of the Russell plant for this purpose is some 225,000 K.W., made up of units of 75,000 K.W., the first of which could be installed for the Fall of 1963.

The power possibilities of the Brazeau Site are much greater. When it is developed the generators will be installed to provide peaking power. Each of the four units there will be rated at 150,000 K.W. so that its total generating capacity will be 600,000 K.W.

While the ultimate development of the Brazeau plant to produce 600,000 K.W. of electrical power involves a main dam two miles long and with a maximum height of 250 feet, two auxiliary dams will also be needed to contain the ultimate reservoir. It will store 930,000 acre-feet of water, and will have an area of 37 square miles.

At the moment perhaps the most interesting feature of the Brazeau dam is its ability to regulate the flow of water in the Saskatchewan River and to increase the low flow during the winter months. This objective can be accomplished by building the lower part of the dam to permit storage of part of the sites ultimate water capacity. Then when the electrical demand in the Province increases the remainder of the dam can be completed, and generating units installed.

At the same time that hydro units are being installed it will be necessary, of course, to keep adding units in the thermal plants to carry the base load. While detailed plans for the next five years are included under the section headed "Forecast to 1964", reference can be made here to some of the thermal units that are planned in the near future. At the moment construction leading to the installation of the third Wabamun unit - 150 M.W. coal-fired - is under way. The City of Edmonton is installing one 75 M.W. gas-fired steam turbine and has called for tenders for another,

while Canadian Utilities, Limited has placed an order for a 30 M.W. gas turbine for installation in the Fall of 1961 in its Vermilion plant. Calgary Power Ltd. is continuing with work leading to the installation of second units in the Spray and the Rundle hydro plants. These will be rated at 50 M.W. and 30 M.W., respectively, and should be in service in 1960. Another good power possibility that is not yet completely in focus is an extension of the City of Edmonton generating system by locating a coal-fired steam plant in some large coal field such as that on the south side of Lake Wabamun.

Unlike some other regions in Canada where the power authorities are forced to contemplate installing nuclear power or to reach out hundreds of miles to bring in power from the hydro sites of the north, Alberta is abundantly supplied with sources of relatively cheap power. The problem is not one of searching for sites for power plants either thermal or hydro but is rather one of bringing into production whatever may be the most economical site at any given moment. The keynote of Alberta's planning, then, should be to make certain that at any time the next power plant to be built should be the one that will contribute the cheapest power to the excellent network of transmission lines which forms the backbone of the power system of the Province.

In the light of the rapidly rising cost of all commodities and services and of material and labour, the power producers and distributors have done a remarkable job in keeping the retail cost of power down. Electric power is one of the very few commodities or services in Alberta that has not risen in price. While in many parts of Canada rates for power have had to be increased, the private power companies have so far been able to stave off such an increase, and much credit is due to them for their economical planning. How long they can continue to keep from raising rates is hard to say, but we

may hope to see this condition continue for at least a few years to come.

As shown by the map at the back of the Report, the network of high-voltage transmission lines is expanding and being co-ordinated year by year. The major power producers, Calgary Power Ltd., the City of Edmonton, Canadian Utilities Limited and Northland Utilities Limited, are bringing about inter-connections which have the effect of utilizing their generating equipment to its utmost efficiency and this process will continue. For this reason Calgary Power proposes starting a 345 K.V. grid connecting the Wabamun plant with the main load centers of Calgary and Edmonton. Initially lines of 220 K.V. would serve the purpose and cost less, but if their rapid obsolescence is taken into account their carrying charges would be more in the long run.

The Continent of North America is approaching another explosion of population similar to that which commenced after the Second World War. Canada will share in this if it can avoid pricing itself out of world markets. Alberta, which has made such strides in the last decade will go a long way towards doubling its population in the next. Its economy will receive a tremendous boost from gas export. Moreover, with everyone becoming more conscious of the importance of Canada's energy resources and with the setting up of The National Energy Board, Alberta, with the lion's share of these, will undoubtedly have more than its proportional share of the increase in population. Because of the importance of our energy resources studies of our coal reserve assume increased importance. We know that we have about one-half of all the mineable coal in Canada but beyond that our knowledge is somewhat limited as to the exact delineation of our various coal seams and the location of mineable deposits of the order of 100 million tons, which will be required to supply the power plants of the relatively near future. We are only now coming to a realization of the fact that

generally speaking in Alberta, power can be produced from coal more cheaply than from natural gas and similarly that thermal power is cheaper than hydro. Coal will produce our base load of the future, while gas and hydro will find their places - most valuable places - as peak load supplements to power from coal. For Alberta at least, because of its cheap fuels, nuclear power is still far in the future.

One of the many interesting possibilities which fortune has thrown into Alberta's lap lies in the direction of exporting coal-fired power to Eastern Canada. This, in effect, means exporting the energy of our coal by an electrical transmission line. It is the energy in our coal that Eastern Canada needs, not the ashes, and here just over the horizon is a practical and economical method of doing this.

At a recent engineering meeting in Banff, Mr. Cass-Beggs, General Manager of the Saskatchewan Power Corporation, presented a paper dealing with the economies of a large transmission line across Canada from British Columbia to the Maritimes. While the suggestions advanced by Mr. Cass-Beggs are perhaps only of theoretical interest at the moment, and while much more detailed study would have to be given to this idea, its interesting possibilities provide room for thought. According to Mr. Cass-Beggs;

"The economies that might be affected by such an interconnection come from three main sources:

"1. Reduction in the capacity that is held in reserve for contingencies, or that is constructed ahead of demand.

"2. Reduction in peak demand due to increased diversity arising out of our different consumption patterns in different regions, and particularly as a result of the displacement of peaks in the five time zones of Canada.

3. Savings due to the optimum use of minimum cost energy resources and the maximum use of available energy storage.

Mr. Cass-Beggs has estimated the savings that might be made if such a line were in operation during the year 1965.

(a) Reserve Capacity.

The saving in reserve capacity would come about by each province being able to reduce the K.W. it holds in reserve for contingencies and obtaining this reserve from the interconnected system, which would have a total reserve much less the sum of the eight provincial reserves. The saving in capital investment in reserve capacity would be of the order of $150,000,000.00.

(b) Diversity.

The savings to be secured from the diversity arise out of the fact that it is dark in Ontario, for instance, two hours before it is dark in Alberta and Saskatchewan. It is estimated that over the eight provinces 1,500,000 K.W. of capacity could be saved with a consequent saving in investment of $300,000,000.00

(c) Optimum use of Minimum Cost Energy and Maximum use of Available Storage.

"The main resources capable of further development on a large scale (excluding nuclear energy) are coal in the Maritime Provinces, hydro in Quebec, coal in Saskatchewan and Alberta, and hydro in British Columbia. Any development that would permit the flow of energy from East and West towards the center of the country would be advantageous."

"The pattern that might be anticipated for 1965 is that Quebec would generate only with hydro, holding what steam capacity it might have in reserve. From its hydro it would meet all its own needs and export to Ontario, New Brunswick and a small amount to Nova Scotia. Ontario, on the other hand would use all its hydro and generate from coal for part of its

own needs (with some of its steam capacity on stand-by), but would also import from Alberta, Saskatchewan and Manitoba as well as from Quebec. The loads in the bus reach 1,250 megawatts between Saskatchewan and Manitoba and 1,000 between Manitoba and Ontario. It should be noted that no new B.C. hydro power, such as the Columbia River, has been assumed to be available as soon as 1965. Consequently, British Columbia is importing power from Alberta, in 1965".

In 1965 Mr. Cass-Beggs estimates that the annual savings under (c), would be $45,000,000.00 and when this is added to the $43,000,000.00 which would be the annual saving in the year 1965, from (a) and (b) above, the total saving is $88,000,000.00 annually.

Mr. Cass-Beggs estimates that a D.C. line of Plus and Minus 400,000 volts, could easily handle the one million K.W. which might be required to move in one direction or the other, and estimates the cost of this line, etc., to be $300,000,000.00 producing an annual fixed and operating cost of $36,000,000.00. This is to be compared to the annual savings outlined above of $88,000,000.00 and should work out at about one-half a mill per kilowatt hour throughout Canada.

This, then, is a very brief summary of this interesting paper. Mr. Cass-Beggs has done a great service to Canada by setting these ideas out in a preliminary paper.

Comments

Such a scheme, which might be worked out at an inter-provincial level, has some very interesting possibilities for Alberta. In the year 1965, it envisages a transfer of power as shown in the table on the following page. This is over and above any energy that might be generated and used within a province. (This scheme was worked out leaving out any account of the

Mica Creek Dam or the Peace River Power Development, because at the time of writing they were both indefinite. Inclusion of them would change the figures, particularly with respect to export from Alberta to British Columbia).

It should be noted that this scheme foresees a transfer of power from the three provinces which are blessed with an abundance of energy - Quebec with its tremendous hydro potential and Alberta and Saskatchewan with their abundance of coal. While it is too much to hope that such a scheme could be in operation by 1965, it is nevertheless interesting to think in terms of what this could mean.

The electrical demand upon Alberta would be of the order of 1,000,000 K.W. and 7.140,000,000 K.W.H. would be involved at a high load factor of something of the order of 85%. This would involve the building of high load factor, i.e. steam plants, at an estimated cost of $150,000,000.00. Assuming 1.25 pounds of coal per K.W.H. we would use nearly 4,500,000 tons per year to produce 7,140,000,000 K.W.H. Alberta coal production in 1958 was 2,350,000 tons of which 1,514,000 tons was exported. If such a transmission line could come into operation by 1965, and if these assumptions are correct, then in that year we could convert nearly double the coal produced in 1958 to electricity and export it. Or, we could convert practically three times the coal that was exported in 1958 to electricity and export it. And 1965 would be only the minimum year. Annual increments after that would be on the basis of not less than 7% compounded, and could be many times that.

MILLIONS OF K.W.H.

Source of Energy	Quantity Available for transfer	Recipient of this Energy	Amount
British Columbia - nil			
Alberta	7,140	British Columbia	3,238
		Manitoba	1,632
		Ontario	2,270
		Total	7,140
Saskatchewan	5,432	Manitoba	3,775
		Ontario	1,657
		Total	5,432
Manitoba	3,633	Ontario	3,633
Quebec	6,570	Ontario	4,146
		New Brunswick	2,374
		Nova Scotia	50
		Total	6,570
New Brunswick	1,053	Nova Scotia	1,053

FORECAST TO 1964

At December 31, 1959, the capacity of the power plants in the Province was 750,000 K.W. At December 31, 1949 - 10 years ago - this capacity was 207,000 K.W., so that the increase during the 10 year period has been 262%, an amazingly large increase. The K.W.H. generated in 1959 were over three and one-half times the amount generated 10 years ago and showed an increase of more than 14% over the corresponding figure for 1958. The increase in peak load over 1958 was 13%. The peak day occurred in November, while December was a relatively mild month. Had the weather in December been normal a higher peak might have been expected. Calgary Power Ltd. experienced a higher percentage increase in peak than the Province as a whole.

While a rate of increase of 14% in K.W.H. generated, with a corresponding increase in peak load, is very high, it is quite possible that the Province's electrical load will continue to grow at somewhere near this rate for the next few years. The population of the Province is increasing, new industries are coming in and the prospects of gas export are all factors that will keep Alberta's rate of electrical growth very high.

Table No. 18 shows the growth which we believe will take place in the electrical load of the Province from now until 1964. It shows the actual capacity in K.W. of the power plants in the Province as at December 31, 1958, the increase in capacity during 1959 and the estimated peak load that occurred in 1959. It then goes on to deal with these year by year until 1964, showing our forecast of peak load and what the Companies and Municipalities are planning to do to meet that load.

It will be seen from a study of Table 18 that there was ample reserve capacity to meet the load in 1959. The Power Commission has always felt that there should be enough reserve capacity in the power plants of

Alberta Government Photo

Alberta's smaller Cities are attracting Industry.
Site of Camrose Tubes Ltd.

the Province so that if the largest unit should break down during the December or January peak load period there would still be enough capacity to carry the load. The largest units in the Province at the moment are the 72,000 K.W. generators in the Wabamun plant. If either of these had broken down during the peak load in December, 1959, the various power plants, by pooling their resources, could have carried the load.

It appears that if the present plans for additional units are carried out we should have ample reserve capacity until 1964. It is hard to predict what the peak load will be five years from now. It will be noted from Table 18 that, while base load units at Wabamun and Battle River are planned, much of the emphasis over the next five years is going to be on peak load units. Additional peak load units are going into Calgary Power's Spray and Rundle plants and further hydro units are expected to come into operation during 1963. Canadian Utilities Limited is installing a gas turbine at Vermilion for peaking purposes. It is anticipated that the provision of these peaking units will permit the steam units to run at a higher load factor and that it may make it possible to give consideration to deferring for perhaps a year the installation of some steam turbines.

TABLE NO. 18

Forecast of Generating Capacity in K.W.
(Not taking account of isolated small plants)

	Capacity added during year	Capacity at end of year	Estimated Peak Load
Capacity at Dec. 31, 1958		717,704	577,000
Capacity added during 1959			
City of Edmonton - gas turbine	30,000		
Northland Utilities Ltd. - Fairview	3,000		
Less minor adjustments	- 1,104		
Capacity added during 1959	31,896	31,896	
Total capacity Dec. 31, 1959		749,600	
		say 750,000	652,000
Capacity to be added 1960			
City of Edmonton - steam turbine	75,000		
City of Lethbridge - gas turbine	10,000		
Calgary Power Ltd. - Spray	50,000		
Calgary Power Ltd. - Rundle	30,000		
Northland Utilities Ltd. - Fairview	3,000		
Capacity to be added 1960	168,000	168,000	
Total capacity Dec. 31, 1960		918,000	762,000
Capacity to be added 1961			
Canadian Utilities Ltd. - gas turbine	28,000		
Capacity to be added 1961	28,000	28,000	
Total capacity Dec. 31, 1961		946,000	868,000
Capacity to be added 1962			
Calgary Power Ltd. - Wabamun	150,000		
Northland Utilities Ltd. - Fairview	5,000		
Capacity to be added 1962	155,000	155,000	
Total capacity Dec. 31, 1962		1,101,000	980,000

- carried forward -

TABLE NO. 18
continued

Totals brought forward -		1,101,000	980,000
Capacity to be added 1963			
City of Edmonton - steam turbine	75,000		
Calgary Power Ltd. - Russell	75,000		
Northland Utilities Ltd. - Jasper	1,200		
Capacity to be added 1963	151,200	151,200	
Total capacity Dec. 31, 1963		1,252,200	1,097,000
Capacity to be added 1964			
Canadian Utilities Ltd. - Battle River	32,000		
City of Lethbridge	20,000		
Capacity to be added 1964	52,000	52,000	
Total capacity Dec. 31, 1964		1,304,200	1,217,000

During 1959, 4,075 farms have been added to the number already electrified in the Province to make a total of 49,923 bona fide farms electrified as at the end of the year. It is expected that another 3,000 farms will obtain Central Station service during 1960.

According to the 1956 Census, 79,424 farms were being operated in Alberta but only 70,058 of these were farms on which someone lived. The remaining 9,366 were being operated mainly by farmers who lived in towns or villages but did not live on their farm. Of these 70,058 farms, 739 were on Indian Reserves and if we deduct these we are left with the remainder of 69,319. If we accept the Census figures, which were compiled during the summer of 1956, then 72% of all farms were electrified as at the end of the year.

But it is sometimes difficult to find all the farms that the Census shows. Since 1956 and particularly in the grey-wooded soil areas, many farmers have left their land. The Saskatchewan Power Corporation conducted a survey during 1958 and came to the conclusion that at that time there were only 91.5% as many farms in that Province as were reported by the Census a year or so previously. If we presume that this percentage holds true in Alberta then there should be 91.5% of 69,319, or 63,500 farms, in the Province on which someone lives. If that is the case then, at the end of 1959, 79% of all the farms were electrified.

In previous reports a detailed map was included which, as the years went by, showed the remarkable progress made in farm electrification. Now that these lines have been built into all the farming areas of the Province it does not seem necessary to continue it as a feature of the annual reports.

Alberta Government Photo

Another important Industry
Sugar Beet Refinery at Taber.

The map on Page 44 shows the Census Divisions in the Province as at 1956, and also shows diagrammatically the percentage of the farms in each Division which were electrified at the end of December, 1959. This percentage is based on the number of farms on which someone lived at the time of the 1956 Census.

It will be seen by the map, which shows the saturation of farm electrification by Census Divisions as at December 31, 1959, that throughout the richest farming areas (Census Divisions 2, 3, 5, 6, 8 and 11) the saturation is very high and that it becomes less in Divisions 1, 4, 7, 10 and 13. Census Divisions 9, 12, 14 and 15, include the fringe areas where agricultural income is the least and where, therefore, we might expect to find a smaller percentage of the farms electrified. Even in these areas, however, a very complete framework of farm lines exists. It is these areas that have benefited most by the application of Part II of the Revolving Fund Act. The future increase in the number of farms electrified will be generally confined to these areas.

It is not likely that very many more farms will be connected in Census Divisions 2, 3, 5, 6, 8 and 11. It is also unlikely that the saturation of electrified farms in Census Divisions 1 and 4 will ever increase into the 90% range because many of the farms and ranches in these two areas are so far removed from their nearest neighbours that for them farm electrification is impractical. On the other hand, we expect a large increase in the saturation in Census Divisions 12, 13, 14 and 15. Generally speaking, the existing network of lines covers these Divisions so completely that the lines are within a mile or two of a very high percentage of the farms in them. Here and there around the fringes of settlement there may be about 10 small groups of 15 or 20 farms each which, because they may be isolated by a gap of 5 miles or so from the nearest farm adjacent to existing lines, have not found it practical to get service. In other words, except for the farms in the Keg River and

Fort Vermilion areas the network of lines makes it possible for nearly all farms to hook up.

There are approximately 40 farms in the Keg River area and some 250 in the vicinity of Fort Vermilion and in the area west from there to High Level. Those in the Keg River area are at present too far removed from any source of power to make electricity economically attractive to them. The farms from High Level to Fort Vermilion and down into the LaCrete area have power available from Northland Utilities' plant at Fort Vermilion. A Rural Electrification Association has been formed in that region but so far there appears to be little interest in building lines.

When the farms not yet electrified but adjacent to lines will take service is another matter. Our experience in all areas south of Edmonton indicates that once the lines are built the farmers who could have taken service from them but did not hook up originally, came on within 5 or 6 years. Some 85% of the 4,075 farms hooked up in 1959 were served by short taps off existing lines. While in the part of the Province from about Edmonton south the process of the reduction of the number of farms due to consolidation into larger units appears to have almost reached a limit for the time being, this process is still going on in Census Divisions 12, 13, 14 and 15. There are many farmers who have power lines going past their doors who have not taken service due to uncertainty on their part as to whether or not they are going to stay on the farm. It is possible that the very fact that power is available will be sufficient to induce them to remain on the farm, but essentially that decision will have to be made on the basis of farm economics.

The following table shows the number of farms connected as of December 31st, 1959, as well as those still under construction. It also shows the number of non-farm customers served off farm lines.

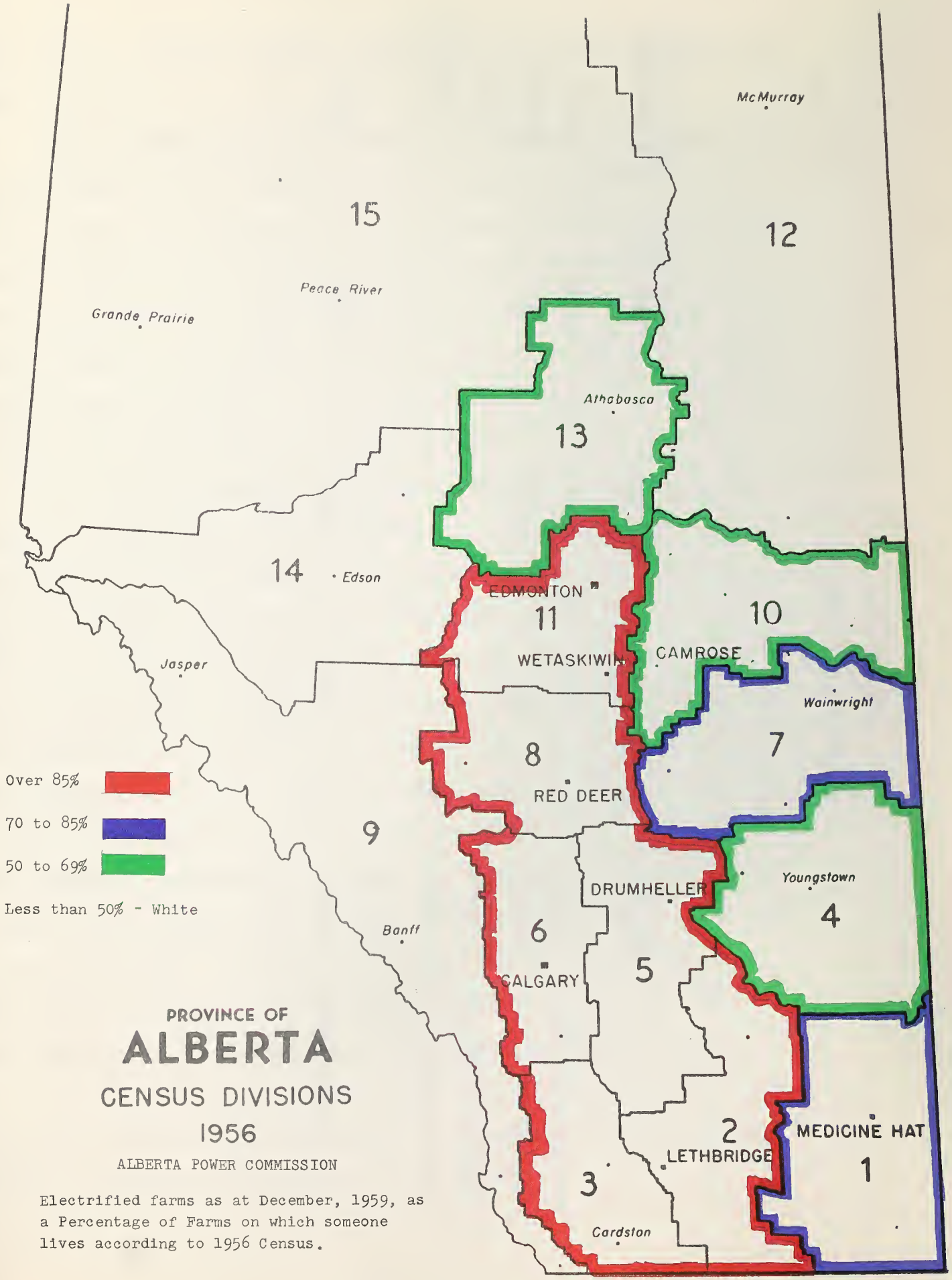
TABLE NO. 19

ALBERTA POWER COMMISSION

Combined figures for Alberta.

Farm Electrification as at December 31, 1959.

	No. Farms Connected	Non-Farms	Hamlet Customers	Total Non-Farm Customers	Total Served off Farm Lines
Experimental areas	3,130	615	461	1,076	4,206
Completed R.E.A.s	44,656	2,731	3,842	6,573	51,229
Individual Rurals	1,918				1,918
Farms supplied by Cities	219				219
Total Actually Served	49,923	3,346	4,303	7,649	57,572


McMurray
15
12
Peace River
Grande Prairie
Athabasca
13
14
Edson
EDMONTON
11
10
WETASKIWIN
CAMROSE
Jasper
Wainwright
8
7
RED DEER
9
DRUMHELLER
Youngstown
4
Banff
6
5
CALGARY
2
MEDICINE HAT
LETHBRIDGE
1
3
Cardston
Over 85%
70 to 85%
50 to 69%
Less than 50% - White
PROVINCE OF
ALBERTA
CENSUS DIVISIONS
1956
ALBERTA POWER COMMISSION
Electrified farms as at December, 1959, as a Percentage of Farms on which someone lives according to 1956 Census.

While there are 49,923 bona fide farmers connected, farm electrification also served 7,649 non-farm customers who would not have obtained service otherwise. The total number benefiting by the construction of these farm electrification lines is, therefore, 57,572.

At the end of December, 1959, there were 37,996 miles of farm lines and during the year 2,644 miles had been constructed.

Financing

At the end of December there was a total of 367 active Rural Electrification Associations. These Associations have borrowed under both the Guarantee Act and the Revolving Fund Act and the total of these borrowings has been approximately $36,000,000.00. At December 31, 1959, nearly $18,000,000.00 of this had been paid back. The investment in all rural lines in the Province is approximately $50,000,000.00.

The Rural Electrification Revolving Fund Act has been of great assistance to all farmers who have been connected during the past four years. By the end of 1959 the Power Commission had given approval to 2,122 applications for loans under Part I of this Act. While all of this money had not been borrowed by the end of December, the approvals covered 28,879 farmers at an estimated cost of nearly $34,400,000.00.

During 1959 the Power Commission gave approval to 377 applications for loans under Part I of the Revolving Fund Act for an amount of $4,893,000.00, to give service to 3,852 farms. Of this amount $4,297,000.00 was loaned where no Part II loan was necessary. Of the 3,852 farmers signing contracts under the Revolving Fund Act, 399 of them were in areas that needed the assistance of Part II loans. In such areas Part I loans totalling $596,000.00 were approved in conjunction with Part II loans totalling $149,000.00. The framework of lines in these new Part II areas will make it possible for an additional

297 farmers to connect to them whenever they are ready. The following table shows the position of Part II loans at the end of December, 1959, and covers all loans from the beginning.

Standing of Part II Loans to December 31, 1959

Amount of Part I loans approved in conjunction with Part II loans since inception of Part II -			$4,536,390.00
Amount of Part II loans as initially approved -			1,610,586.00
Cancelled because more farms hooked up after construction started and therefore the loan was not needed -			48,090.27
Total subject to call -			$1,562,495.73
Drawn prior to Dec. 31, 1959 -		$1,533,275.73	
Refunded prior to Dec. 31, 1959 -		493,205.35	
Total part of that actually drawn which is still outstanding -		$1,040,070.38	
Amount of money authorized but not yet drawn from Treasurer -		29,220.00	
Total number of farmers in areas having Part II loans -	8,622		
Number of farmers taking service initially -	3,449		

During the period since the inception of Part II loans the Power Commission has approved Part II loans totalling $1,610,586.00. In some cases construction of the lines for which these loans were approved has not been started and other cases not advanced to the point where the money has to be paid out. For this reason, of the total amount authorized, $29,220.00 has not yet been disbursed. Of the total of $1,533,275.00 which was disbursed, $493,205.35

has already been paid back because of farmers who have hooked up to the lines which were made possible by these loans.

The existence of Part II loans made it possible to build a framework of lines in areas which otherwise could not have obtained service. There were 8,622 farmers in these areas and initially 3,449 of them took advantage of this financial assistance to get their lines built. When the remainder of the farmers in these areas take service it will be possible to pay off the outstanding balance of the Part II loans. Part II loans have made it possible to extend lines to many areas of the Province which otherwise could not have had service. There are very few areas left now which do not have a network of lines and for this reason we do not expect very heavy demands for Part II loans from here on.

Checking Costs

During the year the Commission has checked all the cost statements which the companies send to R.E.A.'s showing the costs of building their lines, and at the Commission's request the Provincial Auditor has audited a sampling of cost statements. In addition to this, some field checks have been made on various farm areas. With very minor exceptions these costs have always been found to be correct. These checks further show that the areas have been constructed at cost. The Power Companies are building these areas at cost and from an engineering standpoint, they are building them efficiently.

The Power Commission feels that it is its duty, not only to investigate problems brought to it, but also to investigate any phases of farm electrification which it believes require study. While the building of farm lines appears very simple and the operation of them is taken for granted, nevertheless there are many intricate problems to be considered if we are to keep all

expenses down to the very minimum. Many questions such as accumulation, investment and use of deposit reserves, monthly versus quarterly billing, card meter reading and operating charge per foot of line, all merit careful and continuous study. As each of these problems is solved a new one arises to take its place. In its engineering and accounting aspects, farm electrification is highly technical and the individual farmer does not have the time nor the opportunity to investigate these matters. The Power Commission feels that one of its main responsibilities is to see that consideration is given to every factor that could possibly reduce the cost of electricity to the farmers.

The question of the correctness of operating charges made to farmers is constantly under study. We believe that the Power Companies are doing a remarkable job of keeping these costs down and of accounting to the farmers for them. In all the years to date, the actual costs have been less than the monthly charges made to the farmer in his power bill, so that at the end of each year the Power Companies have been able to make a refund to the deposit reserves of the Associations. The operating charges made in Alberta appear to be reasonable and compare very favourably with those made by R.E.A.'s who are operating in similar territory in the United States. One of the advantages gained by our farmers which enables the operating charges to be kept low is the rather unique method of operating R.E.A.'s in Alberta. While in the United States the R.E.A.'s are generally larger than they are in Alberta, each R.E.A. maintains its own supervisory, office and operating staff, with the result that its overhead is apt to be high. In Alberta where the expenses of operating R.E.A. lines are pooled over all the farmers being served by any one power company, and where, for instance, Canadian Utilities Limited does the operating for some 12,000 farms, and Farm Electric Services Ltd. does this work for some 35,000 farms, the overhead from a number of small offices is not added to operating expenses. In other words, these companies operate the farm lines and do the billing and

accounting more efficiently than would be the case if this were being done separately by a number of small R.E.A.'s. Unfortunately the utmost efficiency in operating these lines is not enough to keep pace with the inflationary rise in material and labour costs. Increases in cost are gradually narrowing the spread between the actual costs and the nominal operating charge.

The question of the adequacy of the deposit reserves being set aside has been under study for some years. Some of the older lines of the first R.E.A.'s are now approaching the midpoint of their useful life. In general it appears that most deposit reserves will be adequate but there will undoubtedly be some R.E.A.'s in which, because of their high mileage of line per farm, it may be desirable to increase the annual accrual. During the past year the Power Commission has developed a method by which it can assess the adequacy of existing deposit reserves.

After discussing this with the Union of R.E.A.'s it was decided that the Power Commission should set up a system of records of the reserves of all R.E.A.'s. There are some 350 of these in the Province and a schedule is being set up so as to make a detailed study of the reserves of some 70 R.E.A.'s each year. In this way, starting with the older ones, the position of each R.E.A.'s reserve will be examined once every five years. In cases where the deposit reserve appears to be building too rapidly, monthly payments might be suspended for a time. On the other hand, if the deposit reserve appears to be clearly inadequate the Power Commission could recommend to the R.E.A. that the monthly payment be increased. In this way the position of the deposit reserve would be reviewed and revised periodically and any necessary adjustments could be discussed with the R.E.A. and the power companies.

The annual use of electricity per farmer in Alberta during 1959 has been 3,979 K.W.H. This is a considerable increase over the previous year and is

higher than the national average. This consumption per farm indicates how essential electricity is to Alberta farmers. It is most gratifying to know that farm electrification is now available to almost every Alberta farmer.

During 1959 the electricity consumed by farmers accounted for 6% of the total electricity sold in the Province. While farmers use only 6% of the K.W.H. they are responsible for about 13% of the peak load. Even when we get all the farms electrified the percentage which the farmers will use of the K.W.H. generated in the Province will not be large. It is not likely to exceed 6% of the total output.

Since the farmers were responsible for about 13% of the peak load in the Province it means that 13% of the total capacity of the power plants and the transmission lines, or about 80,000 K.W., was reserved for their use. This 80,000 K.W. is a large proportion of total plant capacity and consequently means that a large proportion of the companies' investment in plants and transmission lines is reserved solely for farmers. The companies' investment in this equipment which is reserved solely for the farmers' use will be well over $600.00 for each farm served.

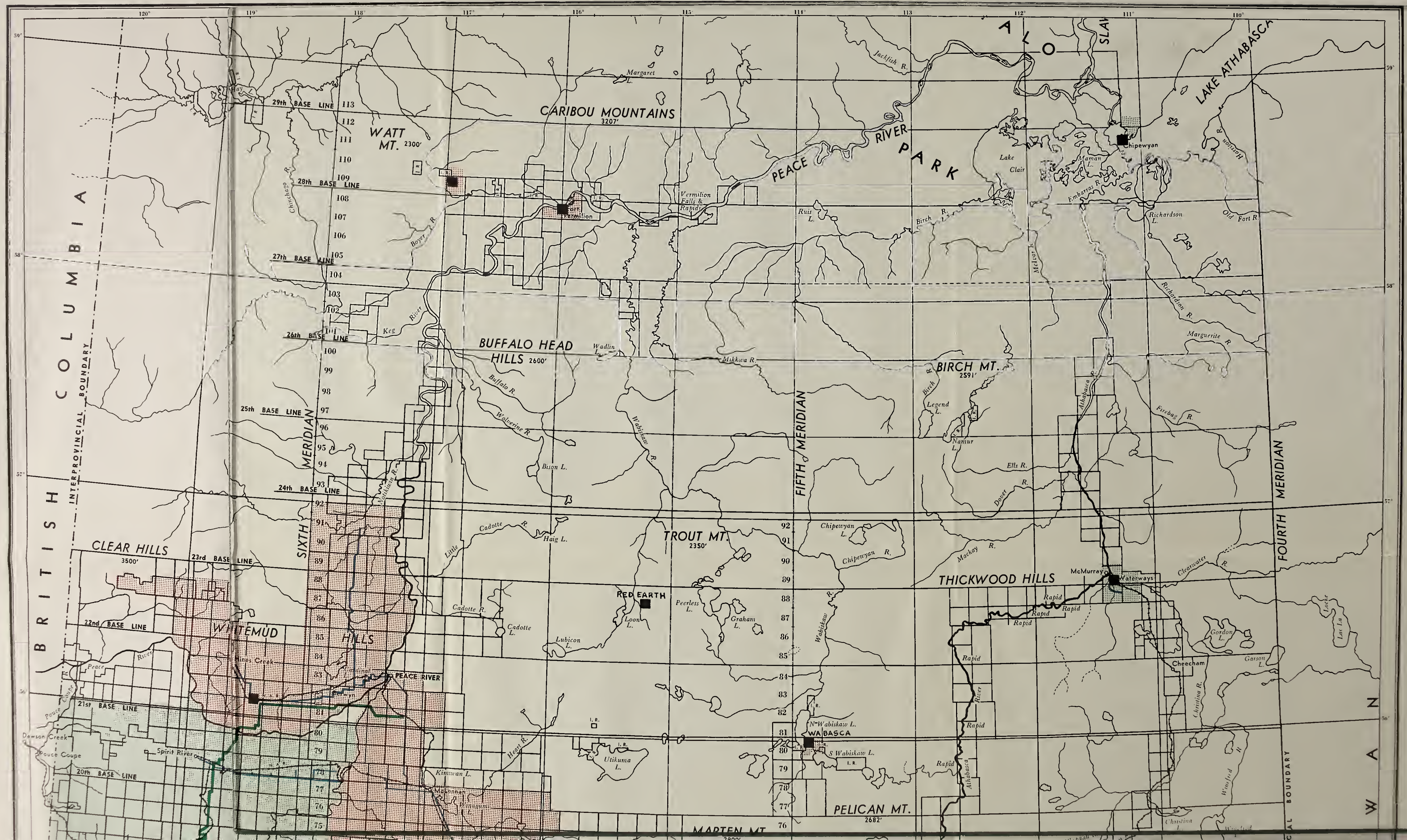
The average farmer's electric load factor is very low and is something of the order of 27% as compared to a Province-wide load factor of about 50%. This question of load factor is an important one and while it confronts many industries, it bears most heavily on the gas and electric utilities. The highest electric peak load of the year usually happens just before Christmas and may have a total duration of only an hour or so on two or three different days at that time of the year. The power companies have to install enough generating capacity to meet that peak even though for the remainder of the year all of this capacity is not used.

Once the generating capacity is installed, and this is particularly so of hydro plants, the cost of operating it 24 hours a day is not such a

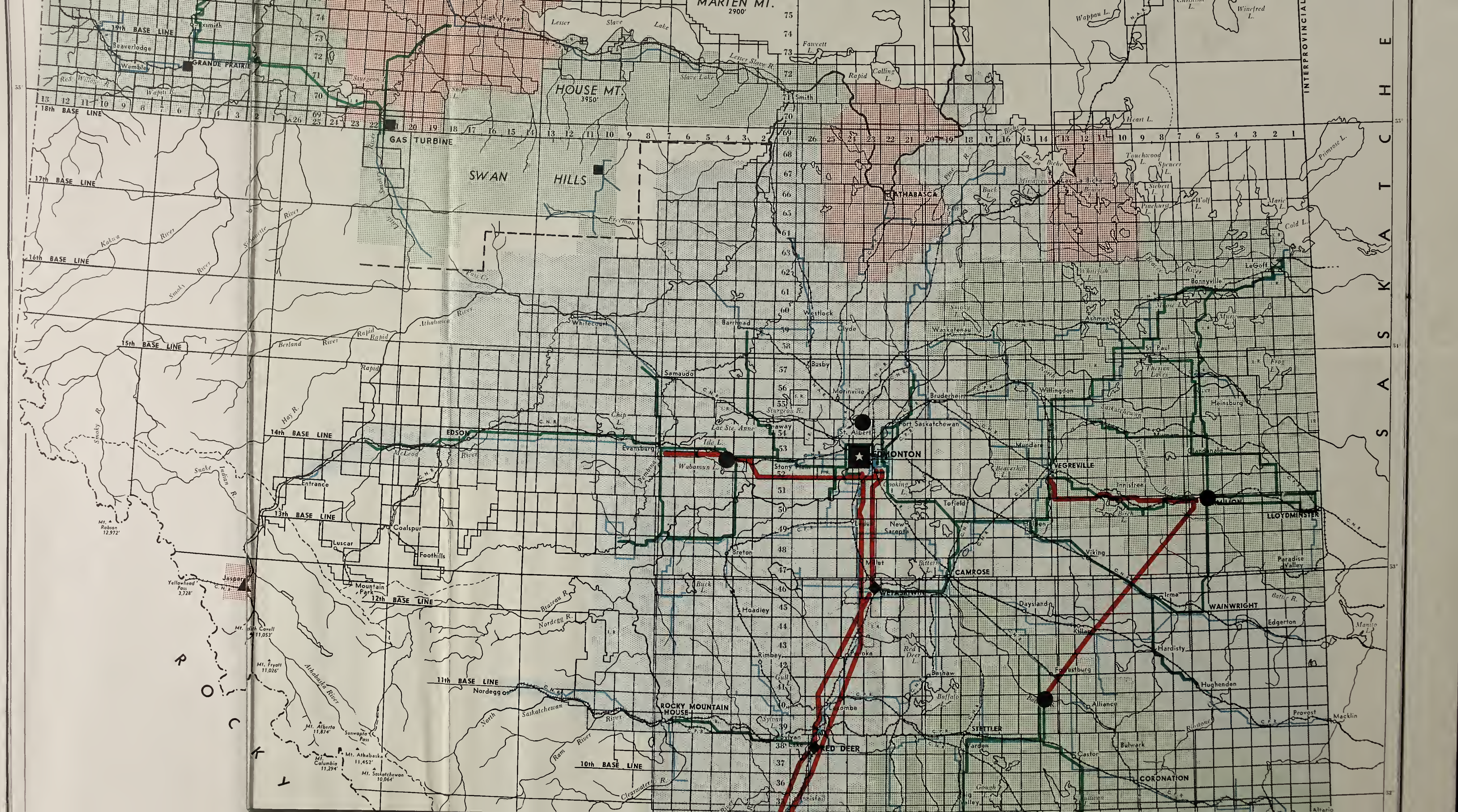
great deal more than the cost of operating it one hour a day. In other words, the cost of generating 24 K.W.H. per day with one K.W. of equipment, is not much more than generating one K.W.H. per day with one K.W. of equipment. This being the case, any customer such as a paper mill in the East, for instance, who can use a fairly constant amount of power for 24 hours a day for 365 days a year, can obtain this power very cheaply. Such a customer has a load factor of nearly 100%. An example of a customer at the other end of the scale would be a community hall used for only a few nights during the winter and therefore having a load factor of possibly 1%. The average load factor placed upon the plants in Alberta is about 50%, - that is, on the average the generators produce only one-half of what they could if the load was such that they could run steadily for 24 hours a day.

The 49,923 farms in the Province fall far below this average of 50% and have an actual load factor of about 27%. Some 80,000 K.W. of generating equipment has to be reserved solely for their use over the peak load period but for the year as a whole it is only used 27% as much as it could be. A rough calculation indicates that if farmers could improve their load factor to, say 37%, then the cost per K.W.H. of the power supplied to them would be reduced about 25%.

In order to improve their load factor farmers would not only have to use more electricity than they do now but would have to arrange their farming operations so as to use the extra power at an off-peak period. While it is probably not possible to make major changes in farming practice in the use of electricity nevertheless this does present an avenue which would lead to reduced power bills so long as all farmers were to work towards that end. It is a subject toward which farmers might direct some thought in the hope of improving their load factor although in practice the cost of electricity is such a small part of the total operating cost of a farm that any saving effected in this manner would be very small.



BRITISH COLUMBIA
INTERPROVINCIAL BOUNDARY
CARIBOU MOUNTAINS
3207'
WATT MT. 2300'
Margaret L.
PEACE RIVER
PARK
LAKE ATHABASCA
Chipewyan
Lake Clair
Maman L.
Embarras R.
Richardson L.
Old Fort R.
Jackfish R.
Vermilion Falls & Rapids
Vermilion
Chinchaga R.
Boyer R.
Ruis L.
Birch R.
McIvor R.
29th BASE LINE
28th BASE LINE
27th BASE LINE
26th BASE LINE
25th BASE LINE
24th BASE LINE
23rd BASE LINE
22nd BASE LINE
21st BASE LINE
20th BASE LINE
Keg River
BUFFALO HEAD HILLS 2600'
Wadlin L.
Mikkwa R.
Buffalo R.
Wolverine R.
Bison L.
BIRCH MT. 2591'
Legend L.
Namur L.
Richardson R.
Marguerite R.
Firebag R.
Athabasca R.
Ells R.
Dover R.
Mackay R.
SIXTH MERIDIAN
FIFTH MERIDIAN
FOURTH MERIDIAN
Wabiskaw R.
Notikewin R.
CLEAR HILLS 3500'
Cadotte R.
Haig L.
Little
TROUT MT. 2350'
Chipewyan L.
Chipewyan R.
THICKWOOD HILLS
McMurray
Waterways
Clearwater R.
WHITEMUD HILLS
RED EARTH
Peerless L.
Graham L.
Loon L.
Cadotte L.
Lubicon L.
Rapid
Gordon L.
Garson L.
Cheecham
Christina R.
Lac La
Peace River
Hines Creek
PEACE RIVER
Dawson Creek
Pouce Coupe
Spirit River
Heart R.
Kimiwan L.
Utikuma L.
N. Wabiskaw L.
WABASCA
S. Wabiskaw L.
PELICAN MT. 2682'
MARTEN MT.
Winefred R.
Christina L.
I.R.



MARTEN MT.
2900'
HOUSE MT.
3950'
SWAN
HILLS
GAS TURBINE
GRANDE PRAIRIE
Beaverlodge
Wembley
19th BASE LINE
18th BASE LINE
17th BASE LINE
16th BASE LINE
15th BASE LINE
14th BASE LINE
13th BASE LINE
12th BASE LINE
11th BASE LINE
10th BASE LINE
Lesser Slave Lake
Smith
ATHABASCA
Whitecourt
Barrhead
Westlock
Clyde
Busby
Morinville
St. Albert
EDMONTON
Fort Saskatchewan
Bruderheim
Stony Plain
Wabamun L.
Evansburg
Entwistle
EDSON
Entrance
Coalspur
Luscar
Foothills
Mountain Park
Jasper
Yellowhead Pass
3,728'
Mt. Robson
12,972'
Mt. Edith Cavell
11,033'
Mt. Fryatt
11,026'
Mt. Alberta
11,874'
Mt. Columbia
11,294'
Mt. Athabaska
11,452'
Mt. Saskatchewan
10,964'
Sunwapta Pass
Nordegg
ROCKY MOUNTAIN HOUSE
RED DEER
Leduc
New Sarepta
Tofield
Millet
WETASKIWIN
CAMROSE
Ponoka
Bashaw
Hoadley
Rimbey
Breton
VEGREVILLE
Innisfree
Mundare
Willingdon
St. Paul
Heinsburg
Bonnyville
LeGoff
LLOYDMINSTER
Vermilion
Viking
Irma
WAINWRIGHT
Edgerton
Paradise Valley
Hardisty
Daysland
Killam
Forestburg
Alliance
Hughenden
Provost
Macklin
STETTLER
Castor
Bulwark
CORONATION
Waskatenau
Ashmont
Samauda
ROCKY
INTERPROVINCIAL
SASKATCHE

ALBERTA

PROVINCE OF ALBERTA CANADA

ALBERTA POWER COMMISSION
MAP OF
TRANSMISSION LINES
IN
PROVINCE OF ALBERTA

Scale: 1 Inch = 20 Miles

19 20 0 20 40 60 59

LEGEND

TRANSMISSION LINES 132 K.V. & OVER
" " 33 K.V. TO 72 K.V.
" " UNDER 33 K.V.
POWER PLANTS - STEAM
- HYDRO
- INTERNAL COMBUSTION

SERVICE AREA
CALGARY POWER
CANADIAN UTILITIES
NORTHLAND UTILITIES

ROCKY MOUNTAINS

HANNA HILLS

WINTERING HILLS

M O N T A N A

INTERNATIONAL BOUNDARY

PROVINCIAL BOUNDARY

COMPILED AND DRAWN IN THE TECHNICAL DIVISION, DEPARTMENT OF LANDS AND FORESTS, EDMONTON, ALBERTA