

**RURAL CANADA
MODELS OF
MULTICHANNEL
REBROADCASTING STATIONS**



PREPARED FOR THE
**DEPARTMENT OF COMMUNICATIONS
GOVERNMENT OF CANADA
OTTAWA**

by
DGB CONSULTANTS INC

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GOVERNMENT OF CANADA, OTTAWA.

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FOREWORD

A significant portion of the population living in rural areas of Canada does not have adequate access to radio and television services.

Modern technology offers several competitive solutions for delivering such broadcast services, namely: direct satellite broadcasting, cable distribution and rebroadcasting network.

DGB Consultants Inc., under contract with the Department of Supply & Services, carried out a study for the Department of Communications to identify and analyse alternative solutions for the design and operation of rebroadcasting stations adapted for low-cost rural service. This Report presents and documents the technical concepts developed to provide low-cost rebroadcasting stations suitable for most of the rural communities found in the ten (10) provinces.

Based on the characteristics of Canadian rural communities, as classified in the studies conducted by the Department of Communications under its Rural Communications Program, a number of standardized rebroadcasting station configurations were developed and their capital and operating costs estimated.

This document reports on the concepts retained. It is organized in three parts, as follows:

PART I - MANAGEMENT SUMMARY contains a brief description of the basic rebroadcasting station Models retained and summarizes the major findings and recommendations of the study.

PART II - REBROADCASTING STATION MODELS discusses in detail the factors which have led to the choice of the four basic models for TV and FM, and two basic Models for AM radio. The applicability of each Model to specific regions and types of community is also discussed.

PART III - COST OF REBROADCASTING STATIONS discusses the assumptions made in the preparation of capital and operating cost estimates, and provides an assessment of the degree of confidence attached to the cost figures developed for each basic Models. Several simplifying assumptions were necessarily made. Nevertheless, the method used for estimation offers a reasonable basis for comparing the economic feasibility of the retransmission approach with that of alternate solutions, such as: cable distribution and direct satellite broadcasting.

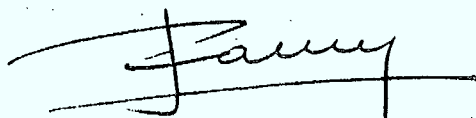
Definite costs of any particular stations will vary depending on factors such as: terrain types, local conditions, distances from existing broadcasting stations, interference problems, form of ownership and level of quality desired.

In addition, the attached Appendices present supporting cost data on which the conclusions presented in the body of the Report were established.

ACKNOWLEDGMENTS

The project team would like to acknowledge with thanks the assistance received, particularly, from Mr. Fernand Léger and Mr. Arnie Lillemark, Department of Communications whose comments were invaluable in reviewing the progress of the work and several important aspects of the study, and also the collaboration received from the various suppliers and other external organizations which have provided us with valuable information.

DGB Consultants Inc.



Daniel Y. Zann, Eng.
Vice-President

for the project team

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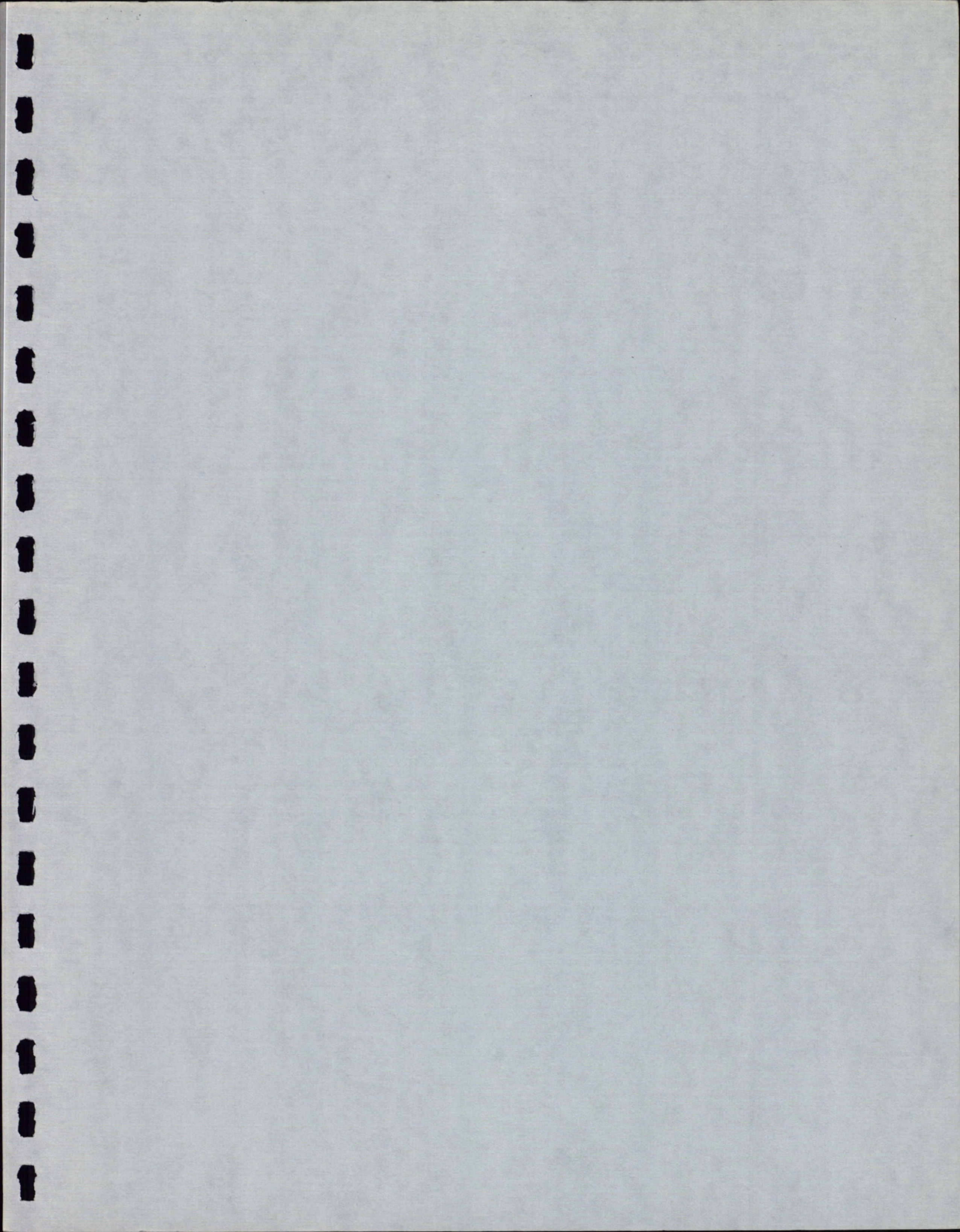
This glossary consists of simplified definitions of terms and abbreviations used throughout this report.

- Community:** Refers to a grouping of households in rural areas which are intended to be served by the rebroadcasting stations developed in this study.
- Model:** Refers to the typical configurations of rebroadcasting stations developed to accommodate either television, FM and AM radio channels.
- Rural Canada:** Consists of the area outside of communities greater than 2,500 inhabitants and excluding those remote areas where the population density is less than one inhabitant per square mile.
- Annual cost:** Refers to capital cost annualized over 15 years at 12% per year compounded semi-annually plus annual recurring cost.
- Capital cost:** Includes costs of engineering, electronics and other materials required for the installation of rebroadcasting station Models.
- Recurring cost:** Includes electricity and maintenance costs together with spare parts and labour.
- Translator:** Refers to the equipment which receives a television signal "translates it to another channel and amplifies it for re-transmission".

PART I

MANAGEMENT SUMMARY

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PART I - MANAGEMENT SUMMARY

1. EXECUTIVE SUMMARY

1.1 PURPOSE OF THE STUDY

The purpose of this study was to develop a number of Models of multichannel rebroadcasting stations able to deliver radio and television services to rural communities in Canada. The concept of each Model is evolved from the typical geographical characteristics of communities in rural regions. Cost estimates for each basic Model and its variations are based on two assumptions: "average terrain" and "typical installation requirements".

1.2 RURAL COMMUNITIES IN CANADA

Several distinctive characteristics of Canadian rural communities are of prime importance of this study, namely: population, spread, terrain roughness and climate. Besides these geographical considerations, two other determining factors which must be considered are accessibility of transmitting and receiving sites as well as ground conductivity in the area. DCEB

A recent study (1), carried out by the Department of Communications, shows that rural communities in Canada range from the closely knit types, called "settlements", to sparsely populated types spreading over about 14 miles radius. The following table gives a classification of communities based on their spread and number of households taken from that study.

Type of Communities	Typical number of households	Typical spread
Settlement	175	Up to 2 miles
Urbanizing	475	Up to 4 miles
Lineal	1,230	Up to 8 miles
Areal and dispersed	100 to 200	Up to 14 miles

The settlement type is mostly in British Columbia, Newfoundland, Ontario and Quebec; the urbanizing type is mainly found in Ontario and Quebec; lineal is mostly in Ontario, Quebec and in the Maritimes; and finally, the areal and dispersed types are usually on the Prairies, and in Ontario and Quebec. Settlement, urbanizing and lineal types of communities represent about 70% of the population in Rural Canada.

1.3 MODELS OF REBROADCASTING STATIONS

To provide TV and FM radio services to these communities, four station Models, the configuration of which is illustrated in Figure 1, are proposed:

- Model no. 1: Pole-mounted Model
- Model no. 2: Standard shelter Model
- Model no. 3: Specialized shelter Model
- Model no. 4: Existing housing Model

In general terms, the applicability of each Model can be summarized as follows:

- the pole-mounted Model is suitable for settlements requiring a 2-mile coverage and for large communities requiring up to 4-mile coverage;
- the standard shelter Model is more suitable to provide coverage of more than 4 miles;
- the specialized shelter Model will find good application for settlements in mountaneous areas;
- the existing housing Model will find general application in settlement types of communities. In the case of communities spreading over large areas, the building used will have to be located on high ground or equipped with a high mast for the antennas.

Coverage of odd-shaped communities and of isolated farmhouses lying at the limit of a community can be provided through the proper selection of antennas or through the optimization of station design.

For technical reasons, the pole-mounted and specialized shelter Models can only accommodate up to four TV and two FM channels. The standard shelter and existing housing Models can accommodate up to eight TV and two FM channels. A mix of television transmitters and translators is provided for in all Models so that off-air feed as well as direct feed from a microwave link, a cable, a satellite earth station or a local studio can be used in each specific case.

Co-location of AM transmitters with TV and FM installations is not recommended because of potential interference problems. Consequently, two additional Models are proposed for delivering AM radio service only. A 50-watt Model and a 250-watt Model, both using a simple wire antenna and ground grid arrangement, have been developed.

1.3 MODELS OF REBROADCASTING STATIONS (cont'd)

The 50-watt AM Model will be found suitable for settlement types of communities in all regions except British Columbia and Newfoundland, where the poor ground conductivity calls for the use of the 250-watt Model. This 250-watt Model is also appropriate for larger communities in the Prairies, Ontario, Quebec and the Maritimes.

A 250-watt Model with a vertical antenna mast and better ground system providing improved coverage may be required for large communities in British Columbia and Newfoundland and for exceptionally large communities in the other provinces.

1.4 COSTING OF MODELS

Cost estimates of the Models are based on the use of commercially available standard electronic equipment. Similarly, installation cost estimates were based on: commonly accepted designs; electric power available at the site; no clearing and levelling work required and readily accessible sites. Furthermore, no cost was allowed for test equipment normally provided by maintenance technicians.

The budgetary cost of installing any of the Models anywhere in Canada be projected from the data included in this report and the attached appendices. However, such estimates will need to be adjusted in accordance with local conditions and the prevailing characteristics of each specific installation.

The following table summarizes the capital cost estimates of the basic Models for a 4-TV channel plus 2 FM and 8-TV channel plus 2 FM stations operating in either VHF or UHF bands.

Description of Models	Basic Coverage	4 TV CHANNELS + 2 FM		8 TV CHANNELS + 2 FM	
		VHF	UHF	VHF	UHF
Model no. 1	2 mi.	\$ 61,000	\$ 88,000	N/A	N/A
	4 mi.	\$ 74,000		N/A	N/A
Model no. 2	8 mi.	\$179,000	\$298,000	\$296,000	\$534,000
	14 mi.	\$253,000	\$389,000	\$426,000	\$677,000
Model no. 3	2 mi.	\$ 59,000	\$ 87,000	N/A	N/A
Model no. 4	2 mi.	\$ 50,000	\$ 78,000	\$ 76,000	\$132,000

Annual recurring costs for maintenance and operation of the above Models are also summarized in the following table.

1.4 COSTING OF MODELS (cont'd)

Description of Models	Basic Coverage	4 TV CHANNELS + 2 FM		8 TV CHANNELS + 2 FM	
		VHF	UHF	VHF	UHF
Model no. 1	2 mi.	\$ 4,050	\$ 4,050	N/A	N/A
	4 mi.	\$ 4,150	-	N/A	N/A
Model no. 2	8 mi.	\$ 9,100	\$ 12,400	\$ 12,600	\$ 20,100
	14 mi.	\$ 11,500	\$ 14,500	\$ 16,300	\$ 24,000
Model no. 3	2 mi.	\$ 2,450	\$ 2,450	N/A	N/A
Model no. 4	2 mi.	\$ 2,450	\$ 2,450	\$ 2,900	\$ 2,900

Because it is not recommended that AM stations be co-located with TV and FM stations, the two AM Models were costed separately, as follows:

Description of Models	Capital Cost	Annual Recurring Cost
50-watt AM Model	\$ 22,000	\$ 2,000
250-watt AM Model	\$ 39,000	\$ 2,700

1.5 EFFECTS OF REGIONAL AND LOCAL CONDITIONS

Particular conditions prevailing in each region including: climate, terrain, electricity rate, labour cost and accessibility of sites will have an impact on the actual cost of implementing specific stations.

In general, however, when dealing with broad regions, variations in regional conditions do not have a significant impact on the estimated cost of the basic Models. In fact, local conditions such as accessibility and clearing of sites will be mostly responsible for significant deviations in actual costs from those of the basic Models. In practice, one will find capital and operating costs somewhat higher in British Columbia (4% to 8%) and Newfoundland (5% to 10%) because of regional conditions.

1.6 ANALYSIS OF COST ESTIMATES

Although, direct comparison with CATV services must be done with caution because their rates include a share for administration and importing remote TV signals, nevertheless it is assumed that an amount of \$100 per year per household is a reasonable price to pay for implementing, as a community effort, a rebroadcasting station.

1.6 ANALYSIS OF COST ESTIMATES (cont'd)

On that basis, the following table illustrates the theoretical size of community required to support the installation of the proposed Models.

MINIMUM NUMBER OF HOUSEHOLDS SUBSCRIBING

Description of Models	Basic Coverage	4 TV CHANNELS + 2 FM		8 TV CHANNELS + 2 FM	
		VHF	UHF	VHF	UHF
Model no. 1	2 mi.	130	160	N/A	N/A
	4 mi.	150	-	N/A	N/A
Model no. 2	4 mi.	-	270	-	N/A
	8 mi.	340	550	550	970
	14 mi.	470	690	770	1200
Model no. 3	2 mi.	110	150	N/A	N/A
Model no. 4	2 mi.	100	140	140	220

Considering the household density shown in column "Households per cell", of Table 1, we note from the above table that settlement type of communities should have sufficient population density to support up to 4 VHF or UHF television channels plus 2 FM programs using either Model no. 1, Model no. 3 or Model no. 4.

For urbanizing and lineal types of communities, it seems that up to 8 TV channels plus 2 FM programs can be supported in a majority of cases.

Areal and dispersed types of communities would not be able, in general, to acquire TV or FM services at the same basic rate as the other communities.

However, since population densities of several communities are much lower than the national average reproduced in Table no. 1 and the particular shapes of communities are different from the assumed circular distribution, several communities may be, in practise, unable to avail themselves of any television services at a reasonable cost.

Presented as an example, the following table gives an order of magnitude of the average annual costs for providing rebroadcasting distribution of television and FM programs to all households in Rural Canada.

1.6 ANALYSIS OF COST ESTIMATES (cont'd)

Type of Communities	Number of Households (million)	AVERAGE YEARLY COST PER HOUSEHOLD	
		4 TV CHANNELS - 2 FM	8 TV CHANNELS - 2 FM
Settlement, Urbanizing and Lineal	1.18	\$ 50	\$ 80
Areal and dispersed	.53	\$272	\$ 436
TOTAL	1.71	\$119	\$190

Considering that about 25% of the communities in British Columbia, 67% in Alberta, 60% in Saskatchewan and 69% in Manitoba belong to the areal and dispersed types, we believe that the rebroadcasting approach in these provinces would require subsidies that could range between \$168 and \$336 per household to maintain this annual cost at \$100. In such cases, direct broadcast satellite appears to offer a more cost effective approach.

1.7 COST REDUCTION OF MODELS

The cost estimated for each Model is an average based on typical conditions. It is, therefore, possible that these basic costs may be reduced. In particular, the following avenues could be investigated:

- optimization of the station design when applied to specific communities;
- preparation of standard plans and specifications for the civil, electrical and mechanical works required by the various models. The design could be frozen for various configurations in all cases except where "existing housing" and AM radio Models are required. However, even in these last cases, some degree of standardization is possible and desirable;
- low-cost, low-power equipment specifically developed for rebroadcasting TV and FM rural applications. Justification of this approach requires more study to establish potential domestic and export markets;
- share of maintenance costs between neighbouring communities;
- use of common design and engineering assistance by several communities when planning and installing rebroadcasting stations in any specific region.

1.8 SUMMARY OF CONCLUSIONS

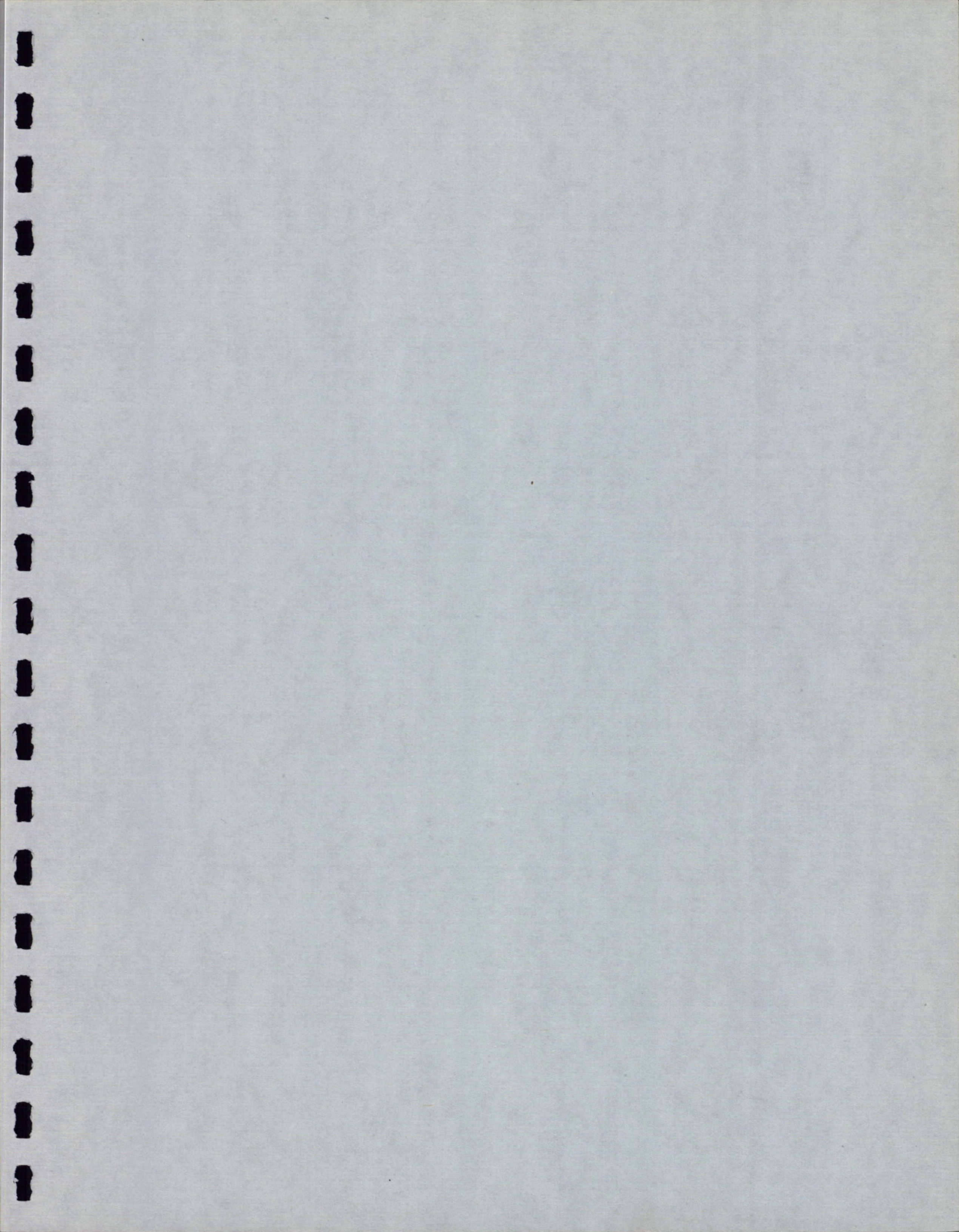
The preliminary work carried out in the course of this study has shown the potential application of rebroadcasting that may be a technically and economically feasible alternative for distribution of television and FM radio programs to rural communities in Canada.

The rebroadcasting solution appears to be an economical and attractive solution to deliver TV and FM signals to the homes in a majority of cases. Unfortunately, it can be shown that the cost per household will be too expensive for areal and dispersed types of communities which represent about 30% of the households in Rural Canada.

Four basic Models of rebroadcasting stations, each with its own options, should be sufficient to provide satisfactory TV and FM services to almost every community in rural areas.

Several associated studies remain to be done:

- establishment of criteria and guidelines for the selection of broadcast or cable solutions, or whatever, in any particular areas;
- frequency allocation ensuring the availability of frequencies in rural areas;
- integration of rebroadcasting equipment with other equipment, such as satellite receiving antenna for the importation of signals;
- direct cost comparison of both alternatives in typical areas and communities where rebroadcasting and cable system seem to be equally valuable;
- improvement of block-translators performances to permit the development of cheaper low-power broadcasting stations;
- beyond the technical considerations of this study, several important questions must be raised regarding economical and commercial impacts that the installation of rebroadcasting stations might have at the national and local levels on the broadcasting industry and cable operators.



2. SUGGESTIONS AND RECOMMENDATIONS

Based on the findings and conclusions of this Study, the following suggestions and recommendations can be formulated for the development of an implementation program of television services in Rural Canada, and to confirm the validity of the proposed Models by implementing pilot stations in selected areas.

2.1 GENERAL RECOMMENDATIONS

- a) A market survey taking into account both technical and commercial aspects should be conducted to support the definition of national policies and the establishment of implementation programs across Canada.
- b) The Canadian electronic industry might consider extending the scope of such a market study to encompass foreign markets in order to establish potential needs in Canada and abroad for rebroadcasting equipment.
- c) An analysis of the economical impact of the proposed implementation scenarios of retransmission services on the broadcast industry and cable operators in the regions should also be conducted in parallel with the development of governmental policies in this matter.

Such an analysis must include a study of possible organization structures at the local, regional or provincial levels which would have the responsibility to operate and to maintain a rebroadcasting network in their respective regions. Possible ways of generating advertising revenues as the means of financing casting services should be discussed. In any case, the importation of distant signals for retransmission would have a bearing on the business viability of cable operators.

- d) In parallel with other studies, the industry might stimulate, if justified, by previous conclusions, the development of special hardware and packaging techniques to ease the selection and the installation of multichannel rebroadcasting stations.

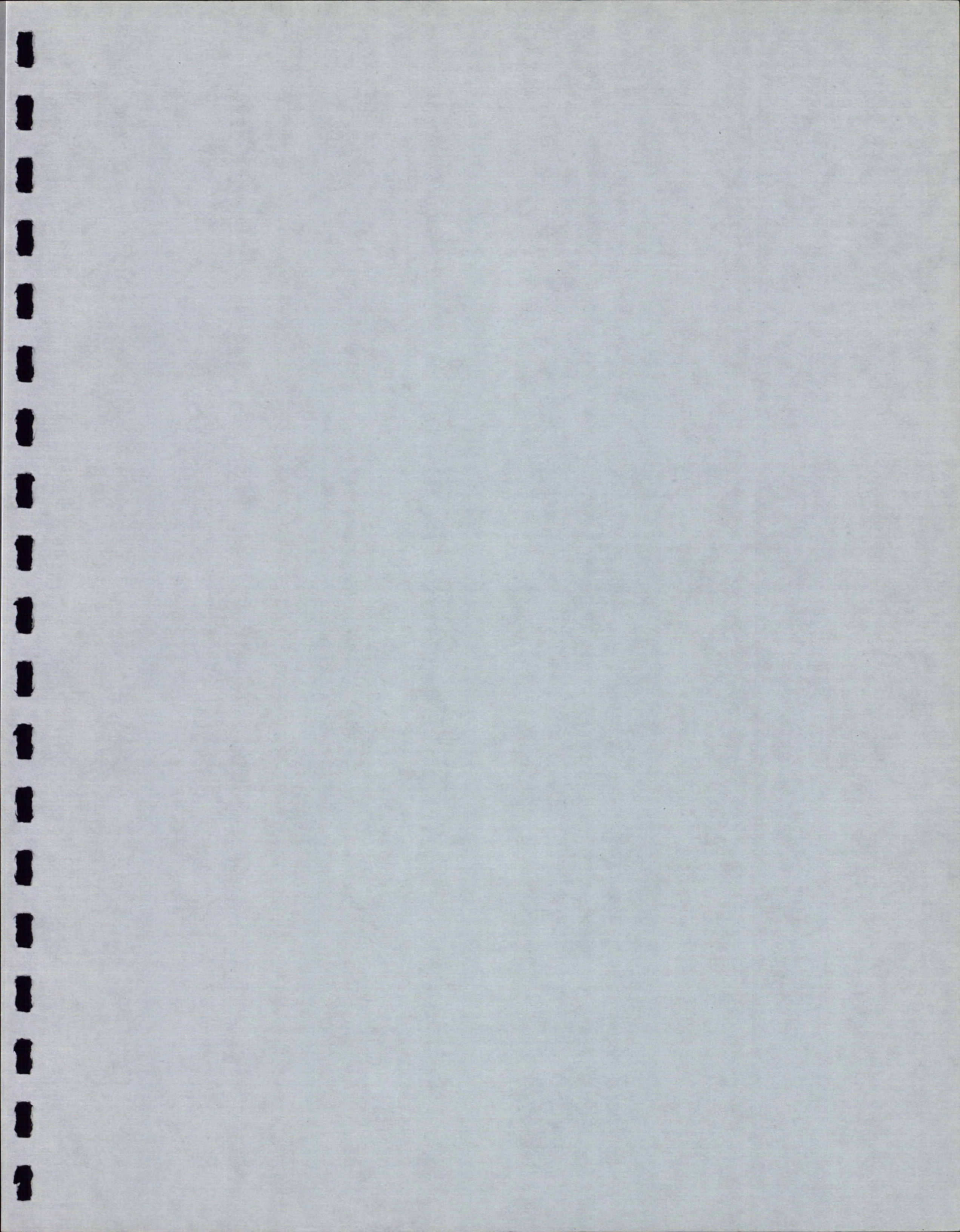
2.2 TECHNICAL RECOMMENDATIONS

From a technical point of view, it is recommended that:

- a) The final configuration of any given rebroadcasting station, using a standard Model, be tailored to the particular environment to ensure that the needs of that community are met in the most economical way possible.

2.2 TECHNICAL RECOMMENDATIONS (cont'd)

- b) A prototype of each Model should be implemented and tested in the field to optimize the final design of standard Models and to tighten up the cost estimates.
- c) One or two experimental areas should be selected as representative regions to conduct a direct cost comparison and a detailed evaluation of the advantages to the population of rebroadcasting compared to those of cable systems.
- d) Further investigation should be carried out on the use of TV sub-carriers to bring additional audio programs to rural communities.
- e) The possibility of relaxing some criteria of DOC Standards BP 14 and BP 22 regarding the requirements for establishment of low power TV and FM broadcasting stations or the feasibility of extending the applicability of BP 15 to more powerful stations might be envisaged as a means to reduce costs.
- f) In the present circumstances, the VHF band must be preferred for economical reasons. But, new technology now under development should permit in the near future the competitive use of translator based on transmitters suitable for several UHF channels.
- h) Governments should sponsor the preparation of design guidelines and standard specifications and drawings for the basic Models. In addition to direct savings in engineering, this approach will permit quantity purchasing of equipment.



3. OVERVIEW OF THE STUDY

3.1 INTRODUCTION

As part of the Rural Communication Program, the Federal Government has established within the Department of Communications a system engineering study group to investigate ways and means of improving television services to the population living in Rural Canada.

In fact, television services available in rural areas is far lower in both level of quality and choice of program than those available in urban areas.

3.1.1 Objectives

This study is intended to complement the work (1) (2) (3) (4) already done under the Rural Communications Program in providing technical and cost data that can then be used to estimate the capital investment needed to provide the desired broadcast coverage in Rural Canada in the most economical way.

More specifically, its objective is to develop and evaluate the technical feasibility and the cost-effectiveness of several configurations of multichannel rebroadcasting stations meeting the requirements of typical communities in Rural Canada.

3.1.2 Terms of reference and design guidelines

The terms of reference of the study are given below, under two sub-headings. Although the wording has been modified in some cases, all statements are consistent with the approved scope of work.

Scope of work

- a) Develop, on paper, various models of multichannel broadcasting stations for use in rural communities in Canada.
- b) Prepare cost estimates for each model of station including capital expenditures and recurring cost.
- c) Present the above costs on a per household or per inhabitant basis. The cost of radio services should be identified separately and presented on a per individual basis.
- d) Compare the estimated costs to the charges which could be reasonably carried by householders.
- e) Discuss ways of decreasing capital and recurring costs.

3.1 INTRODUCTION (cont'd)

3.1.2 Terms of reference and design guidelines (cont'd)

- f) Formulate appropriate conclusions and recommendations.
- g) Evaluate the possibility of extending broadcast services to isolate farmhouses.
- h) Present the results of the study in a final report which will summarize major conclusions and findings.

Design guidelines

- a) Each model must be able to transmit simultaneously up to 4 TV channels and up to 3 AM or FM radio channels.
- b) The same Models should have an expansion capability up to 8 TV channels.
- c) The proposed Models must be developed using equipment already on the market. If existing equipment cannot be found or is found unsuitable to provide technically acceptable configurations at costs comparable with other competing solutions, appropriate alternative recommendations should be formulated.

3.1.3 Population in Rural Canada

Based on the results of other studies (1) (2) prepared by the Department of Communications, it appears that the total number of households involved is about 1,700,000 which covers an estimated area of 377,000 square miles.

These households are grouped in six types of communities:

-Urbanizing	8%
-Lineal	28%
-Dense areal)	
-Sparse areal)	31%
-Very dispersed)	
-Settlements	33%

The total population in rural communities is approximately 6,000,000 inhabitants.

3.2 METHODOLOGY

To meet the objectives and to monitor the progress of the work, the study was carried out in several phases. They are:

PHASE I - Development of Models

- a) The results of other related studies were reviewed to determine the following:
- population and household densities of each type of community;
 - number of communities of each type;
 - typical terrain characteristics, e.g. hilly, flat, wooded, prominent hill or mountainous;
 - climate of the various regions, e.g. wind and ice conditions;
 - other environmental factors, e.g. power availability, accessibility to typical communities and to rebroadcasting sites.
- b) Several models which fit the characteristics of the different types of communities were developed.
- c) Various equipments to be incorporated in rebroadcasting stations were identified, namely: transmitters, translators, antennas, filters and combiners, amplifiers, modulators and power sources as well as buildings, towers, heating and ventilation equipments, etc.
- d) Several installation methods were identified:
- by road, wherever sites are accessible;
 - by helicopter in non-accessible sites;
 - installation in existing buildings and modifications thereto.
- e) Various maintenance methods were also considered:
- frequent visits to easily accessible sites;
 - rugged unattended sites and high-reliability installations;
 - maintenance provided by local resident technician;
 - maintenance provided by travelling technicians.
- f) Several models were discussed and accepted by the Department of Communications at the end of the first phase of the Study.

3.2 METHODOLOGY (cont'd)

PHASE II - Technical evaluation of the Models

The proposed Models were examined technically to:

- a) Determine if they will meet the various Department of Communications technical requirements and specifications for broadcasting stations.
- b) Propose alternative solutions, if they cannot meet the Department of Communications criteria.
- c) Identify ways of simplifying the Models which could also lead to lowering of capital, operating and maintenance costs.

PHASE III - Costing out the Models

- a) Budgetary prices were obtained from the various suppliers whose equipment is suitable for the concerned Models.
- b) Estimation for installation cost.
- c) Based on the above installation costs, estimation of the basic Model costs.
- d) Estimation of maintenance and operating costs for each Model.
- e) Calculation of cost per household for both TV and radio services following discussions with the Department of Communications.
- f) Cost variations due to some important conditions prevalent in the different provinces were investigated and discussed.
- g) Costs were presented on an incremental channel basis from the first channel to the maximum capacity of each Model.

PHASE IV - Comparison of costs

- a) The costs of the Models on a per household basis were compared to the costs of alternative television delivery methods;
- b) Ways of decreasing the costs of the Models were discussed and particularly: the use of common source suppliers; the stimulation of development of lower-cost equipment; the packaging of complete stations; the preparation of standardized specifications; and the design optimization in individual cases.

3.2 METHODOLOGY (cont'd)

PHASE V - Preparation of reports

At the end of each phase, review meetings were held with the Department of Communications to discuss results obtained at that time. Such results presented in the form of internal working documents. The essential information was presented at the end of each phase and the comments so generated were used in the preparation of this subsequent work.

3.3 CHARACTERISTICS OF STATION MODELS

3.3.1 Design constraints and limitations

As originally set-out in the Terms of Reference in paragraph 3.1.2, the design of rebroadcasting station Models was guided by the following constraints and limitations:

Functional requirements

- ability to transmit up to 4 TV channels and 2 radio channels in one case, and up to 8 TV channels and 3 radio channels in the other case;
- capability of extending both television and radio services to isolated farmhouses;
- possibility of rebroadcasting signals received "off-air";
- adaptability to meet the needs of most communities in Canada regarding terrain, coverage and climate.

Technical guidelines

- Models must be simple, easy to install and to maintain;
- each Model must be developed, using commercially available equipment;
- each Model must be modular in design and susceptible of package construction;

Furthermore, the following additional constraints were identified during the feasibility analysis of Models early in the course of the study:

- AM radio service should be kept separate from the FM and TV installations because of mutual interference problems and divergent design criteria between AM and FM or TV broadcasting.

3.3 CHARACTERISTICS OF STATION MODELS (cont'd)

3.3.2 Basic Models for TV and FM services

Four basic rebroadcasting station models were developed to provide FM and TV services. Figure 1 illustrates the configuration of the proposed Models:

Model no. 1 - Pole mounted Model

It consists of a pole on which antennas and equipment housings are mounted.

Model no. 2 - Standard shelter Model

This Model is the most familiar Model consisting of a small building and accompanying steel tower.

Model no. 3 - Specialized shelter Model

It consists of a conical shelter enclosing equipment, short mast, ladder and antennas.

Model no. 4 - Existing housing Model

It corresponds to the case where equipment and antennas are located in an existing building.

Alternative station arrangements are also described in Part II, section 7.3. These variations are proposed either as an attempt to lower Model costs or to overcome specific technical or environmental constraints.

3.3.3 Models for AM services

Two basic Models are proposed for the AM radio service: a 50-watt Model and a 250-watt Model.

Both these Models were based on the use of simple equipment housing, a long-wire antenna and a simple ground arrangement consisting of 16 radial wires.

A variation of the 250-watt Model is also proposed. This variation calls for an equipment housing, a vertical antenna mast and a more elaborate ground grid system.

An AM radio station to cover sparse or dispersed types of communities requires a better antenna system at a cost two or three times higher than that estimated for the proposed Models.

3.3 CHARACTERISTICS OF STATION MODELS (cont'd)

3.3.4 Applicability of the proposed Models

Model no. 1 - Pole mounted Model

This Model is particularly suitable to serve the large number of settlement type of communities. In general, the height of the pole, the type of antennas and the transmitter power can be selected to satisfy the particular coverage pattern required by a given community.

Model no. 2 - Standard shelter Model

The standard shelter Model can be used in any community but will find more general application in lineal, areal and dispersed types of communities.

Model no. 3 - Specialized shelter Model

The specialized shelter Model is particularly suited to provide coverage to small communities in mountainous regions where access conditions are more difficult.

Model no. 4 - Existing housing Model

The existing housing Model thought out to take advantages of suitable space for electronic equipment in a building strategically located in the area to be served. In general, it is intended to cover settlement or urbanizing types of communities. If the selected building is suitably located, such as on a hill-top or is already an existing radio communication installation, it could provide satisfactory coverage to larger communities.

Model no.5 - 50-watt AM Model

This Model is primarily intended to cover settlements and urbanizing types of communities everywhere except most of British-Columbia and Newfoundland.

Model no. 6 - 250-watt AM Model

This Model is intended to provide adequate AM service to larger communities and to British Columbia and Newfoundland, where poor ground conductivity is a problem.

3.4 COST ESTIMATES OF THE STATION MODELS

3.4.1 Assumptions

In estimating the costs of each Model, a number of simplifying assumptions were necessary. These assumptions are discussed in Part III of this report and in the attached Appendices. In brief, the estimation method developed for the costing of Models is based on the following assumptions:

- quoted prices are applicable to the Provinces of Ontario and Quebec;
- costs were assembled from quotations, obtained from several suppliers or from catalogues.

Excluded from the projected cost of Models are:

- provision for cost escalation
- cost of land and property
- royalties
- construction permits
- rents
- legal fees
- tools and test equipment

3.4.2 Costs of station Models

Several Tables included, at the end of the present report, show costs of representative options of each basic Model. However, the cost estimates considered to be of general applicability are those based on high-band VHF. These costs are summarized as follows, for typical configurations of the proposed Models:

Type of Installation	ANNUAL COST	
	First TV Channel	Additional TV Channel
Existing housing model (1 watt)	\$ 5,000	\$ 1,000
Specialized shelter model (1 watt)	\$ 7,000	\$ 1,000
Pole mounted model (2 mi. cover.)	\$ 8,000	\$ 1,000
Pole mounted model (4 mi. cover.)	\$ 8,500	\$ 1,500
Standard shelter model (8 mi. cov.)	\$15,500	\$ 5,000
Standard shelter model (14 mi cov.)	\$20,000	\$ 7,200

3.4 COST ESTIMATES OF THE STATION MODELS (cont'd)

3.4.2 Costs of station Models (cont'd)

Similar results computed for station Models using all UHF channels instead of VHF channels show that UHF installations will be around 40% more expensive.

AM radio service could be provided at the following cost:

- 50-watt AM Model: \$5,100 per year
- 250-watt AM Model: \$8,200 per year

In Part III of this report, sub-sections 9.2 to 9.6 discuss the cost estimates presented in Tables 15 to 29 at the end, from which the above summaries are taken. Furthermore, details of cost estimates used are also given in the Appendices: Appendix A for the civil, electrical and mechanical costs and Appendix B for the electronic equipment.

3.4.3 Cost of alternative Model arrangements

An alternative arrangement using CATV type equipment could be designed to cover small settlements requiring 1-mile coverage or less. Using a pole mounted model, the annual costs would be as follows:

- first TV channel: \approx \$7,500 per year
- additional TV channel: \approx \$ 500 per year

Sub-carriers on TV channels may be provided for an additional one time cost of \$4,000 per channel. But in this case, every household must be equipped with an external decoder to receive the extra radio channel. If the price of this decoder is less than \$50 to householders, this alternative may become attractive for the delivery of one extra FM radio channel for each TV channel.

3.4.4 Regional variations of Model costs

Due consideration has been given to the possible cost variations between the provinces. It was found that, in general, these cost variations are minimal. However, additional expenses should be allowed for, in both Newfoundland and British Columbia, to cover higher transportation costs which may be required to transport the equipment to those remote communities which are not easily accessible.

Such additional costs vary on the average from 3% to 10% of the total estimated cost of each Model. However, variations in costs are likely to be much higher in individual cases.

3.5 MAJOR FINDINGS AND CONCLUSIONS

Major findings and conclusions reached in the course of this Study fall under two categories: technical and economical.

3.5.1 Technical conclusions

- a) To serve all types of communities in Rural Canada, we need four basic Models of TV and FM rebroadcasting stations. Some degree of standardization is possible, but the detailed design of any station should be tailored to each particular environment.
- b) Co-location of AM radio installation with TV and FM stations is neither technically advisable nor cost effective. Therefore, two separate Models are also proposed for AM service.
- c) In general, it will be possible to implement rebroadcasting stations transmitting on 4 or 8 TV channels plus 2 FM radio channels provided certain precautions are taken in the design and the choice of frequencies to prevent interference.
- d) The stations using existing broadcast equipment will meet the applicable DOC Standards. But it seems that developing low powered translator based transmitters or using CATV equipment might offer an economical alternative.
- e) Television translators provide the most attractive solution for delivering broadcast services in rural areas at low cost.
- f) For the time being, the choice of VHF channels is preferred. However, when new technological developments permit the design of block translators suitable for several UHF channels, the UHF band may provide a means to realize more cost-effective stations than is feasible with present technologies.
- g) The combined use of block translator and cable technologies appears to be cost effective in extending television services in areas where population densities are too low to support the cable structure.
- h) The use of sub-carrier on TV channels to carry extra radio programs appears promising. Besides a more effective utilization of the frequency spectrum, such a solution would also reduce the importation cost of TV and radio signals because they would send out a subchannel audio signal together with the main channel signal on the same satellite or terrestrial link.

3.5 MAJOR FINDINGS AND CONCLUSIONS (cont'd)

3.5.1 Technical conclusions (cont'd)

- i) The testing of Models in one or several pilot areas should be considered to permit the assessment of quality of service and resolve implementation problems before standardization can logically be proposed to the industry.

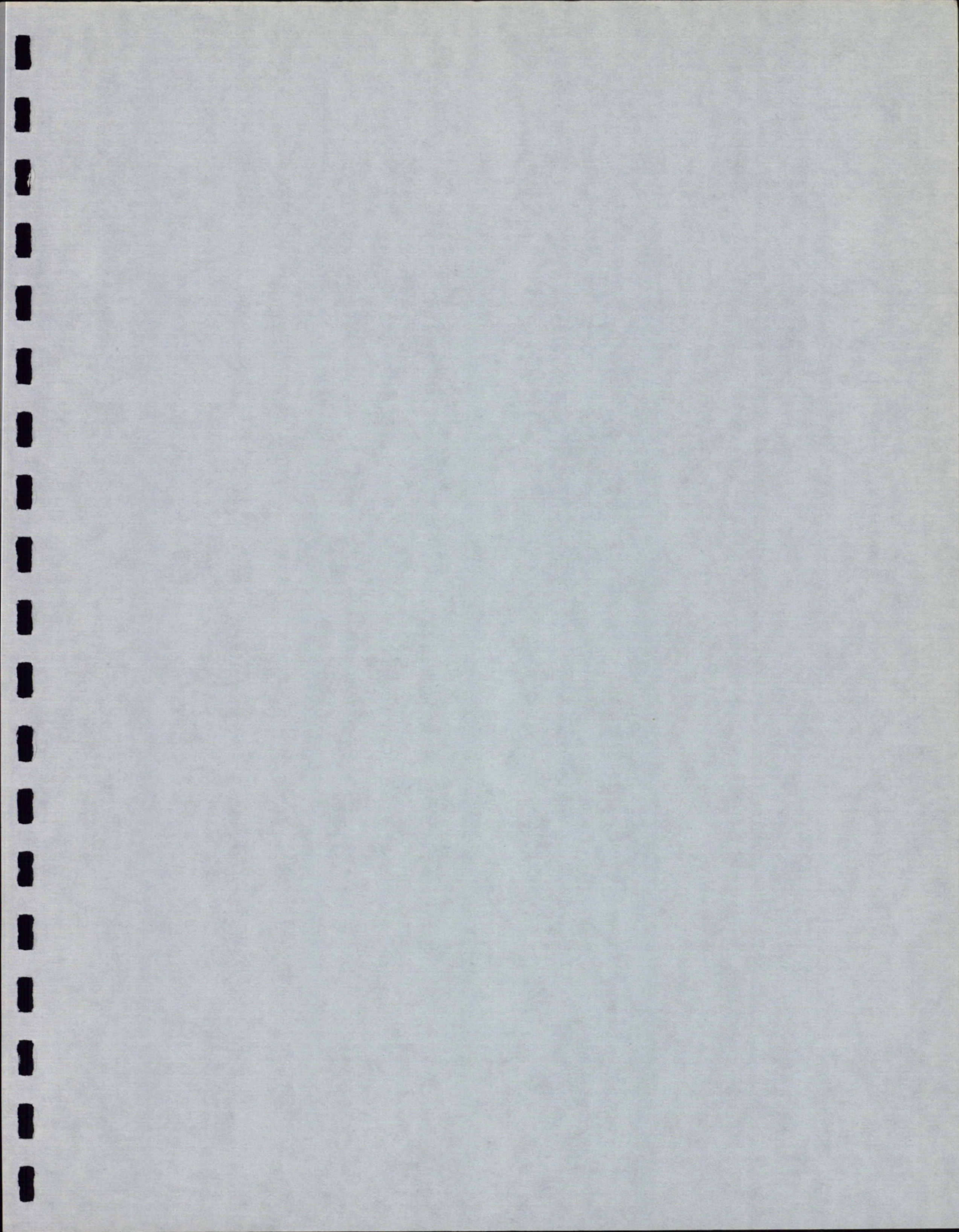
3.5.2 Economical conclusions

- a) Rebroadcasting services seem to be competitive with other methods of delivering television and radio programs to a majority of rural communities. In particular communities, costs will vary from region to region depending on terrain, distance from stations and population density.
- b) Multichannel rebroadcasting is advantageous over cable distribution for delivering a limited number of channels, usually smaller than 5 or 6 channels depending on the type of communities.
- c) At an annual cost of \$100 per household, radio and television services can be provided to about 70% of homes in Rural Canada. But, in some regions such as British Columbia and the Prairies where areal and dispersed types of communities represent respectively between 25% and more than 60% of homes, the same services will cost much more per household.
- d) Models offering not less than 4 TV plus 2 FM channels appear well suited for settlement type of communities.
- e) Models offering up to 8 TV and 2 FM programs can be offered to urban and lineal types of communities counting, at least, 550 households.
- f) Among the 4-channel Models, it appears that the pole-mounted type can be considered as a cost-effective solution for a majority of communities across the country.
- g) The choice of FM radio service is to be preferred over AM because the co-siting of TV and FM equipment reduces significantly the marginal cost of FM services.

PART II

REBROADCASTING STATION MODELS

DCB



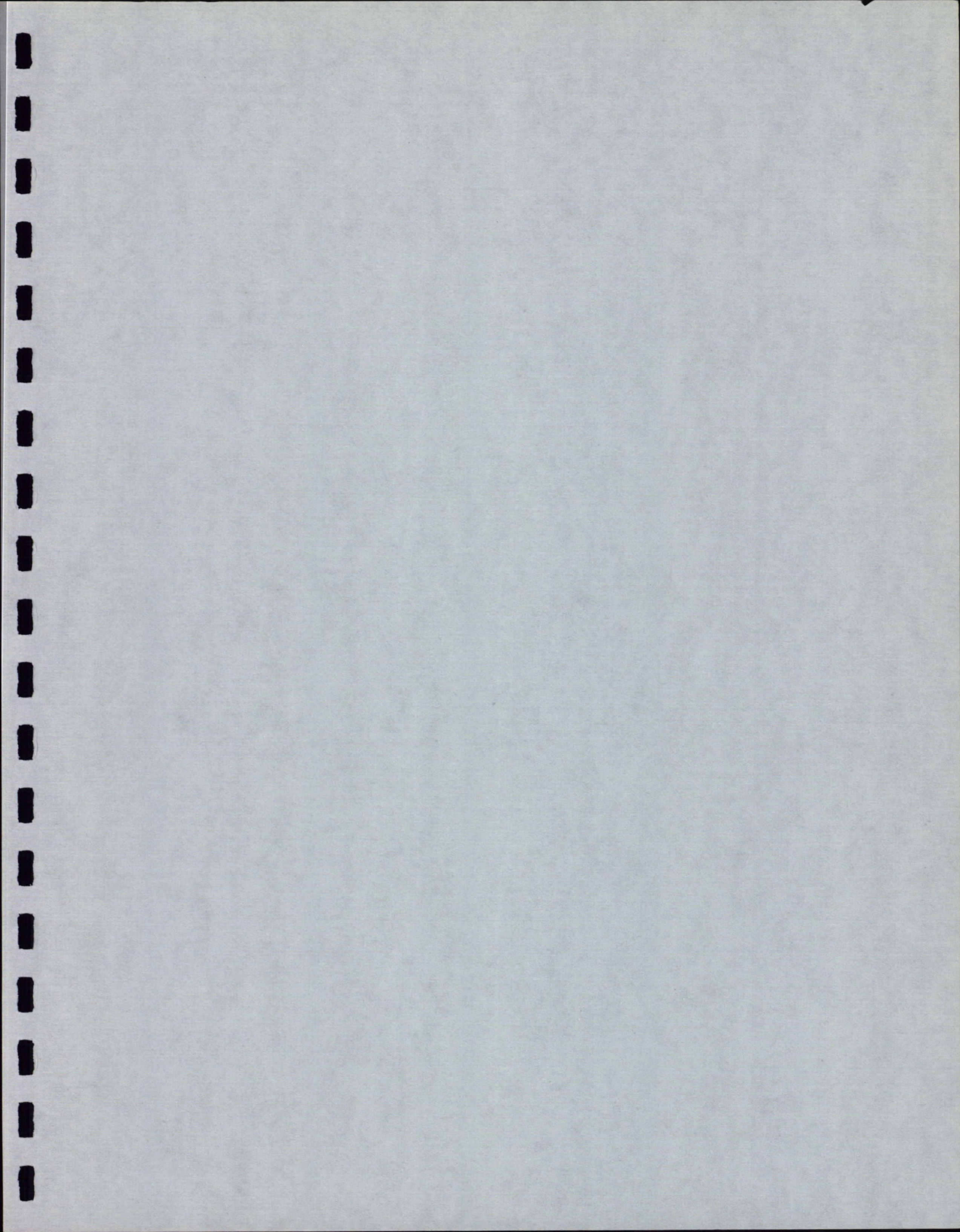
PART II - REBROADCASTING STATION MODELS

4. INTRODUCTION

Part II of this report describes the major characteristics of several Models of rebroadcasting stations which were retained to provide radio and television services to Rural Canada.

The technical considerations and the external factors which have influenced this choice are also discussed. In particular, the geographical and topographical characteristics of typical rural communities in Canada which have an impact on the detailed design of any particular rebroadcasting stations are analyzed.

Finally, some general guidelines on the applicability of the proposed Models to various types of communities are also presented in the following sections.



5. DESCRIPTION OF RURAL CANADA

Rural Canada is defined as including areas outside centers having a population greater than 2,500 inhabitants and excluding remote areas where the population density is less than one per square mile. The dark areas on the map illustrating the front cover show the relative importance and the location of communities forming Rural Canada.

5.1 CLASSIFICATION OF COMMUNITIES

According to previous studies (1)(2) carried out by the Department of Communications, there are approximately 6,000,000 people and 1,700,000 households in Rural Canada. These households are grouped in communities of various sizes ranging from less than 100 households up to about 1,500 households and covering geographical areas from less than one mile to about 14 miles in radius.

Communities were classified in accordance with their density of households into the following six types: urbanizing, lineal, dense areal, sparse areal, very dispersed and settlement.

For the purpose of this study, the dense areal, sparse areal and very dispersed types are grouped in single type referred to as "areal and dispersed".

This classification is found on a two-level sorting procedure: one based on the grouping and the other on the density of households. Thus, a settlement is characterized by a closely knit type of community with a density ranging from 20 to 200 households per square mile and the urbanizing type occupies typically an area wider than the settlement with a population density in the order of 50 households per square mile. Lineal, areal and dispersed types spread out into relatively larger areas with corresponding lower density.

5.2 CHARACTERISTICS OF TYPICAL COMMUNITIES

Table 1 - Size of communities in Rural Canada-gives typical characteristics of existing communities. In this Table, the "households per cell" column indicates the typical number of households of its type. The actual population of any given communities will vary from the typical one.

The column showing the "number of cells" is used as an estimate of the number of communities in each type.

The "number of households" column shows the number for each type of communities in Rural Canada.

5.2 CHARACTERISTICS OF TYPICAL COMMUNITIES (cont'd)

Three sources of potential difficulties were identified in the mentioned studies, namely:

- a) scale-up factor (estimated number of cells)
- b) periphery problem in the Prairies
- c) household groupings outside the central core in the Maritimes.

We did not consider, at this stage, that these difficulties could affect the development or costing of the Models, since the key parameters for a rebroadcasting station, including: spread, total population and population distribution are adequately documented for our preliminary estimates.

Since the scale-up factor is based on preservation of exact household count an inaccuracy exists in certain calculations. For example, the settlement type of community scale-up factor does correctly predict the total number of households in this cell-type, but does not exactly predict the total number of settlements.

5.3 DISTRIBUTION OF HOUSEHOLDS

The distribution of households throughout Rural Canada is shown in the following table:

Type of Communities	British Columbia	Prairies	Quebec/ Ontario	Maritimes	Canada
-Urbanizing	-	2%	13%	-	8%
-Lineal	-	2%	40%	47%	28%
-Areal and dispersed	25%	65%	27%	-	31%
-Settlements	75%	31%	20%	53%	33%

Such a compilation shows three general trends:

- a) In each region, one or two types of communities are generally predominant.
- b) A majority of settlements are found in British Columbia and the Maritimes where rough coastal areas and mountainous terrain are predominant.
- c) Sparsely populated communities are found in the Prairies and other provinces where flat terrain prevails.

5.3 DISTRIBUTION OF HOUSEHOLDS (cont'd)

- d) In Quebec and Ontario where miscellaneous types of terrain are found, all types of communities exist.

5.4 GEOGRAPHICAL CONSIDERATIONS

There are several geographical conditions which affect the configuration and the cost of a rebroadcasting station. Among the most significant of them, it is worth mentioning: climate, terrain, accessibility to transmission site, labour and electricity rates.

Wind velocity and ice thickness call for stronger towers. Hence in the Maritimes and Newfoundland, where such conditions are more severe, the tower will cost more than in Quebec or Ontario and, on the contrary, less in the Prairies.

Rough terrain and thick vegetation tend to decrease the coverage of a television of FM broadcast station. To provide services over large areas having these characteristics, such as in British Columbia, it requires higher towers to achieve the same coverage and hence results in higher costs. In settlement types of communities, terrain is not considered rough since, in general, they spread out over short distances in a relative flat portion of land or on the side of hill.

Poor accessibility to transmitter site increases the cost of installing and maintaining a station. Where this is the case, especially in isolated communities in Southern Newfoundland, Labrador and North West British Columbia; special arrangements will have to be made which will also result in higher costs than for other cases.

Labour and electricity rates vary from province to province and will affect the relative cost of stations accordingly.

These several parameters affect different cost elements of the Models. But taken together, they have less than 5% effect on total costs. However, the increase in cost is greater for Newfoundland where it was estimated to be as much as 10% higher than the average.

5.5 TELEVISION SERVICE IN RURAL CANADA

5.5.1 Present levels of service

Present levels of television service in rural areas are well below that available in metropolitan districts. A recent study (3) on television coverage in Rural Canada shows that on the average 3.85 different channels are available to the population living in these areas as opposed to 12.6 in metropolitan districts.

5.5 TELEVISION SERVICE IN RURAL CANADA (cont'd)

5.5.1 Present levels of service (cont'd)

But the average number of channels effectively delivered in each region varies widely from region to region. As a matter of example, this average number is 1.5 in rural Saskatchewan and it reaches 5.3 in rural Ontario.

5.5.2 Desired service

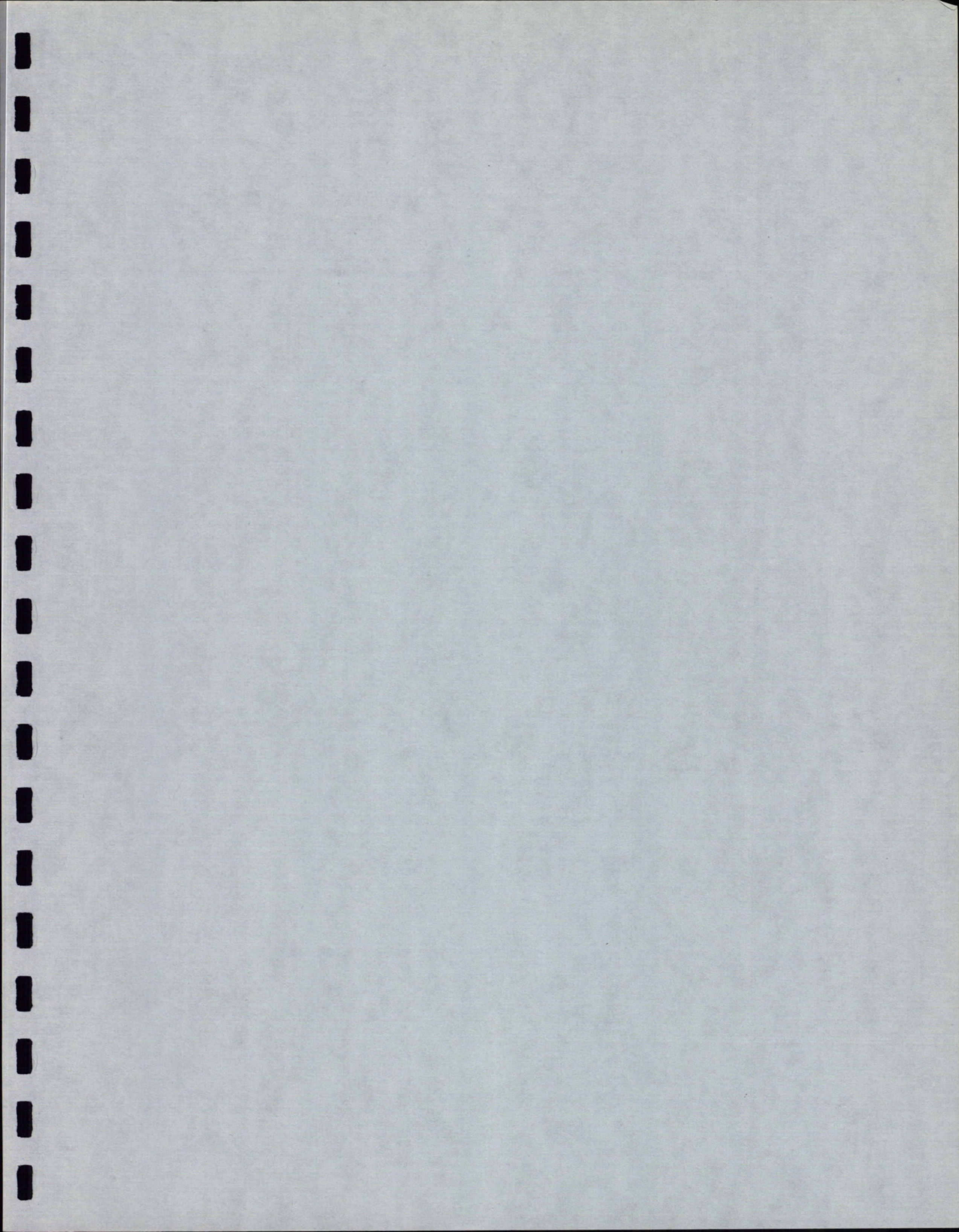
One of the objectives of the Rural Communication Program is to improve the level of services available to communities by delivering a better signal and a greater variety in the choice of programs.

In so doing, the gap in quantity and quality between rural and metropolitan areas will be narrowed.

Multichannel rebroadcasting stations capable of transmitting up to 8 TV channels and 2 FM channels fed either from microwave, off-air or satellite, at an economical cost, is the solution developed in this report.

For the purpose of this study, adequate service was taken to be the grade B contour in television and the 500 $\mu\text{V}/\text{m}$ contour in FM radio of any given rebroadcasting station.

DC:



6. DEVELOPMENT OF THE MODELS

The design approach adopted to arrive at a minimum number of Models capable of providing acceptable service at a reasonable cost, to a maximum number of rural communities, taking into consideration demographical and topographical factors is described in this chapter.

6.1 DESIGN CONCEPTS

Several factors have influenced the design of the basic Models and their possible variations in terms of radiated power and coverage.

Some of the most important ones are discussed in the following sub-sections.

6.1.1 Design constraints and parameters

As dictated by the terms of reference in sub-section 3.1.2, the following design constraints or parameters were set by the Department of Communications:

- ability to transmit simultaneously up to 4 TV channels and up to 2 FM radio channels with an expansion capability up to 8 TV channels;
- use of existing equipment already on the market;
- co-siting of AM, FM and TV facilities. Initially, it was assumed that AM transmission services would be located at the same site as TV and FM transmitting equipment. However, due to potential interference problems and conflicting technical criteria, it is advisable to provide AM radio services from different sites.

Separate Models for AM radio services were therefore developed for use wherever these services are required.

6.1.2 Basic Models

The study established that all types of rural communities could be provided TV and FM services from four basic rebroadcasting station configurations. The Models developed around these four configurations are:

- Model no. 1 - Pole mounted Model
- Model no. 2 - Standard shelter Model
- Model no. 3 - Specialized shelter Model
- Model no. 4 - Existing housing Model

6.1 DESIGN CONCEPTS (cont'd)

6.1.2 Basic Models (cont'd)

Figure 1 illustrates schematically these four Models which are described in more details in section 6.2.

In addition, it was established that two AM radio configurations were required to provide this service to all types.

6.1.3 External design factors

a) Source of power

The design of typical Models is based on the assumption that commercial electrical power is available on site. In such cases, where this is not true, the cost associated with the provision of power will be estimated in accordance with circumstances. Several alternatives are available to the designer such as motor generator sets, thermo electric generators, solar cells or wind generator. The choice will depend on local parameters.

b) Climate

Of all climatic conditions, wind and ice parameters have the most significant effect on the design of the station. As a matter of example, we can expect ice build-up on external structures to be $\frac{1}{2}$ " thick while the same parameters can reach 2".

Reproduced in Appendix C with the authorization of the Canadian Standards Association (CSA), ice and wind maps show applicable loading conditions for every zone in Canada.

In accordance with the CSA recommendations, the following parameters were used in the structural design of Models:

Provinces	Ice Loading	Wind Pressure
British Columbia	1"	13 psf
Prairies	$\frac{1}{2}$ "	10 psf
Quebec and Ontario	1"	13 psf
Maritimes	$1\frac{1}{2}$ "	13 psf
Newfoundland	2"	18 psf

6.1 DESIGN CONCEPTS (cont'd)

6.1.3 External design factors (cont'd)

c) Terrain

Geographical spread and shape of the communities have had more effect on the design of the Models and, only in so far as these are determined by terrain, can design be said to have been affected by it. For example, settlement types of communities are considered to be flat even though they cover a small area.

However, the situation is different in the case of AM radio. Propagation is then greatly affected by ground conductivity, it will require the use of more powerful transmitters in British Columbia and Newfoundland.

d) Accessibility

In general, accessibility of both communities and of transmitter sites present no particular difficulty. Nevertheless, transportation to some communities in Southern Newfoundland, in Labrador and British Columbia may require special sea or air accommodations.

Also, some access roads and clearing work may be required because readily accessible sites are not adequate for the purpose of rebroadcasting stations. The costs involved in such situations will have to be assessed on a case by case basis.

e) Availability of construction material

Construction material such as sand, gravel and cement are assumed to be readily available everywhere in Canada, where rebroadcasting stations might be installed.

6.1.4 Design options

a) Multiple coverage capability

Each basic Model has the capability to be configured to provide several coverage radius. For example, the pole mounted Model can be equipped for either 2 or 4-mile coverage, and the standard shelter Model can be economically configured to provide radius of 4, 8 and 14 miles. Furthermore, a particular coverage pattern is always achievable by the proper combination of transmitter power and antenna directivity.

6.1 DESIGN CONCEPTS (cont'd)

6.1.4 Design options (cont'd)

b) Frequency band

TV frequency spectrum is very crowded and any new services must afford protection to existing services. The selection of frequencies will be more critical in Southern areas, particularly in the VHF band; and it should be done for every station.

A possible way to obviate this problem would be the allocation of several blocks of frequencies in the UHF band for broad-band communications in Rural Canada.

6.2 FUNCTIONAL CHARACTERISTICS OF MODELS

A schematic illustration of the configurations of the four basic Models is shown in Figure 1; a complete list of equipment considered for each Model appears in Appendix A for the civil, mechanical and electrical equipment and Appendix B for the electronic equipment.

DC:

6.2.1 Model no. 1 - Pole mounted Model

a) General description

The pole mounted Model has its equipment located in a weather-proof or environmental enclosures which can be either attached to the mast or located on 4' pedestals at about 5' above ground level. As an alternative, the environmental enclosure could be mounted on a concrete slab at the foot of the pole. Transmitting and receiving antennas are installed on top of the pole.

b) Applicability

This Model is more suitable for 1 or 10-watt stations with limited coverage that is of the order of 2 to 4 miles.

The height of the pole is a limiting factor for both transmission and off-air reception.

c) Installation and maintenance

The installation of this type of Model is normally quite easy and its implementation costs are minimal.

6.2 FUNCTIONAL CHARACTERISTICS OF MODELS (cont'd)

6.2.1 Model no. 1 - Pole mounted Model (cont'd)

d) Advantages and disadvantages

However, this Model is more subject to vandalism than other Models, especially in the case of the alternative, where the equipment enclosure is at ground level.

Maintenance during winter can be more difficult because the enclosure is directly exposed to the elements and does not provide shelter for the technician.

6.2.2 Model no. 2 - Standard shelter Model

a) General description

This Model consists of a standard communication shelter with an antenna structure located beside the building. This type of shelter comes in the form of a trailer or pre-fabricated building of standard dimensions or pre-cut sections to be assembled on site. D/C/B

In some cases, an antenna supporting mast can be erected on the roof when it is not necessary to have a much higher elevation for reception or transmission.

Figures 4 and 5 show the typical layouts for a 4 and 8 TV channels rebroadcasting station.

Dimensions of the building were established on the basis of the number of racks and transmitters necessary for a 4 TV-2FM stations and for a 8 TV-2FM stations which require respectively 3 racks and 5 racks.

Each building allows for one additional rack to take care of cases where a transmitter or translator of more than 100 watts in VHF and more than 10 watts in UHF could be required in certain circumstances.

b) Applicability

This Model is applicable to most regions and terrain types, as long as the site is easily accessible, at least by four wheel drive vehicle in summer and by snowmobile during winter.

6.2 FUNCTIONAL CHARACTERISTICS OF MODELS (cont'd)

6.2.2 Model no. 2 - Standard shelter Model (cont'd)

c) Installation and maintenance

The installation of this Model requires the erection of a building and a tower. The transmitting and receiving antennas are installed on this tower.

An extension could be made to the building for a power room, if it is found that an alternate power service is required.

The maintenance is expected to be easy if the site is accessible, since work will be done inside.

d) Advantages and disadvantages

Space is provided inside the building for a working area, storage cabinet for spare parts and documentations as well as for other auxiliary equipment such as electrical panels or RF loads is also provided.

6.2.3 Model no. 3 - Specialized shelter Model

a) General description

This Model was conceived around a special shelter available from Sinclair Radio Labs and designed for installation at sites which are difficult of access.

The antennas are located inside the shelter itself.

Figure 6 shows a typical equipment layout inside this shelter. It can easily accommodate the two racks of equipment required for a low power 4 channel rebroadcasting station. If necessary, a third rack could be added, and although space would be crowded, it will still provide a workable configuration. A characteristic of this Model is the fact that the antennas are located inside the shelter itself.

b) Applicability

The use of this Model is restricted to low power output stations because of its limited size. The coverage is therefore highly dependent on the ground elevation of the site on which it is installed.

6.2 FUNCTIONAL CHARACTERISTICS OF MODELS (cont'd)

6.2.3 Model no. 3 - Specialized shelter Model (cont'd)

c) Installation and maintenance

The installation will be difficult since the shelter is specifically intended for use in remote and hard of access sites. For the same reasons, maintenance will also be more costly than average.

d) Advantages and disadvantages

Although, it is possible to accommodate transmitting equipment for more than 4 low power transmitters, the effective number of channels is limited by the space requirement of the antennas. Working space inside the shelter is also very limited. Complete stations can be assembled and tested on manufacturers' premises because this type of shelter may be transported either by truck or by helicopter.

6.2.4 Model no. 4 - Existing housing Model

DCE

a) General description

In this last case, the equipment is simply installed in an existing building close by or within the community to be served. Antennas are mounted on the roof or on an adjacent tower. If enough space is available, the layout would be similar to that of the standard shelter Model.

b) Applicability

The existing housing Model was mainly designed to provide coverage to communities of the settlement and urbanizing types.

c) Installation and maintenance

Installation of antennas on top of existing buildings may require the erection of some special structure. In other cases strengthening of an existing structure may also be required. Maintenance is expected to be as easy as for the standard shelter Model.

6.2 FUNCTIONAL CHARACTERISTICS OF MODELS (cont'd)

6.2.5 Configuration of AM radio station

For AM radio service, an independent configuration is proposed. It consists of transmitting equipment suitably housed which feeds a long-wire antenna strung between two poles. In regions where it is needed, a simplified ground system can be added to improve the antenna efficiency.

Two models, a 50-watt and a 250-watt, have been developed to provide coverage to all types of communities: settlements, urbanizing or lineal with a long wire antenna.

A third model using a 250-watt transmitter, a standard quarter wave vertical antenna and a suitable ground grid is needed to provide adequate service to sparse and dispersed communities or to those with poor ground conductivity.

6.2.6 Interconnection of TV and FM equipment

Illustrated by the block diagrams appearing on Figure 2 for a 4 TV-2 FM stations and on Figure 3 for a 8 TV-2 FM rebroadcasting stations, the interconnection of TV and FM equipments is described in the following paragraphs. **DC:**

It should be noted that all Models are designed for unattended operation. Consequently, all equipment necessary for this mode of operation e.g. on/off carrier sensor or time clock is assumed to be incorporated with the equipment and is not shown on the block diagrams.

a) TV Rebroadcasting

The TV signals to be rebroadcasted can be picked-up off-air or else brought to the transmitting site by other means such as cable or satellite feed. When it is picked-up off-air, a VHF/FM and/or UHF receiving antenna is used. If the received signal is strong enough, and the channel separation permits it, splitters may distribute the antenna signal to the input of two or more receivers. An RF input filter may be used, when necessary, to limit the bandwidth. In cases of weak signals, this filter will help reduce adjacent channel interference and attenuate strong signals in the area.

In cases of off-air pick-up, the rebroadcast equipment will likely consist of a TV translator which has the advantage of introducing less distortion, of being less expensive, and of requiring less test equipment than the transmitter/modulator and amplifier arrangement.

6.2 FUNCTIONAL CHARACTERISTICS OF MODELS (cont'd)

6.2.6 Interconnection of TV and FM equipment (cont'd)

a) TV Rebroadcasting (cont'd)

However, the use of a TV modulator and amplifier will be required if local program insertion is needed.

The cost of the equipment also includes a RF harmonic filter at the output of the power amplifier, a directional coupler, a power detector and a transmitting antenna. When the frequencies permit it, several transmitters may be duplexed on one single antenna.

Equipment requirement for direct feed of local programs is similar, except that a TV transmitter is needed instead of the translator and the TV receiver.

An audio limiter is sometimes necessary when the audio signal brought in via a land line is subject to level variations.

b) FM rebroadcasting

Functional description of the FM portion of the system is very similar to the TV functional block diagram. Components are mostly of the same type as for TV. The FM transmitter and the FM translator provides the same functions as in the case of TV.

The signal picked-up off-air can be received by the same antenna as for VHF-TV, especially in low band, if the levels are sufficiently high.

c) AM rebroadcasting

Functional description of the AM configuration is slightly different than in TV and FM Models, but the components perform the same functions. An antenna coupler is used to match the impedance at the output of the transmitter to the antenna. No off-air receiving is intended on the AM band. Nevertheless, we should note that signals could be picked-up off-air on the AM band.

6.3 ALTERNATE SOURCES OF POWER

In cases where no electrical power from utilities is readily available, the following sources of power may be used as alternates:

6.3 ALTERNATE SOURCES OF POWER (cont'd)

6.3.1 Propane and diesel generators

These conventional generators have been used for a long time in the industry. They can easily supply the energy required to operate a 4 or an 8 channel rebroadcasting station. If installed with large fuel reservoirs, they will operate unattended for several months. However, diesel motors require frequent routine maintenance and may prove too unreliable for isolated installations.

6.3.2 Wind generators

Although quite new, wind generators are now available on the market. One type suitable for the purpose (two 6' high columns) produce enough power to feed a low-power rebroadcasting station. This type of generator may require a big installation consisting of a base and a tower for the generating units. Operating efficiency increases with tower height above ground level. Unfortunately, it may be subject to operating problems in regions where frequent icing conditions exist.

6.3.3 Thermo-electric generators

This type of generating unit is readily available. They usually burn propane gas. The TELAN type which was selected for our investigation generates about 90 watts; up to 9 units can be connected together, if required to increase the power capacity.

6.3.4 Solar power cells

The type considered for the study consists of 3' x 4' panels which keep a battery set charged. One such panel has a peak power output of about 30 watts, and coupled with rechargeable batteries could feed two 1 watt TV translators. Stations powered by solar cells are already in operation in British Columbia. A specific study of the available sunshine has to be carried out to assess the feasibility of these units in all areas.

6.4 MAINTENANCE SERVICES

Whenever a technician is locally available; he might perform regular maintenance on one station on a contract basis. However, if the situation lends itself to it, it would seem more advantageous for several stations in an area to jointly retain a specialized firm or a technician to carry out on a group of stations. By so doing, it is possible to arrange orderly visits to each station so that preventive maintenance is performed on a rotation schedule. The same firm or technician would be on call to repair faults occurring between routine visits.

6.4 MAINTENANCE SERVICES (cont'd)

In brief, approach to maintenance which we believe should receive considerations is illustrated by the following scenarios:

- a) One resident of the community being served will assume the responsibility for calling the technician in case of station failure.
- b) Someone will be hired from time to time to carry out minor site maintenance.
- c) A firm or a technician will be retained to service and maintain the station in accordance with the following guidelines:

Preventive maintenance

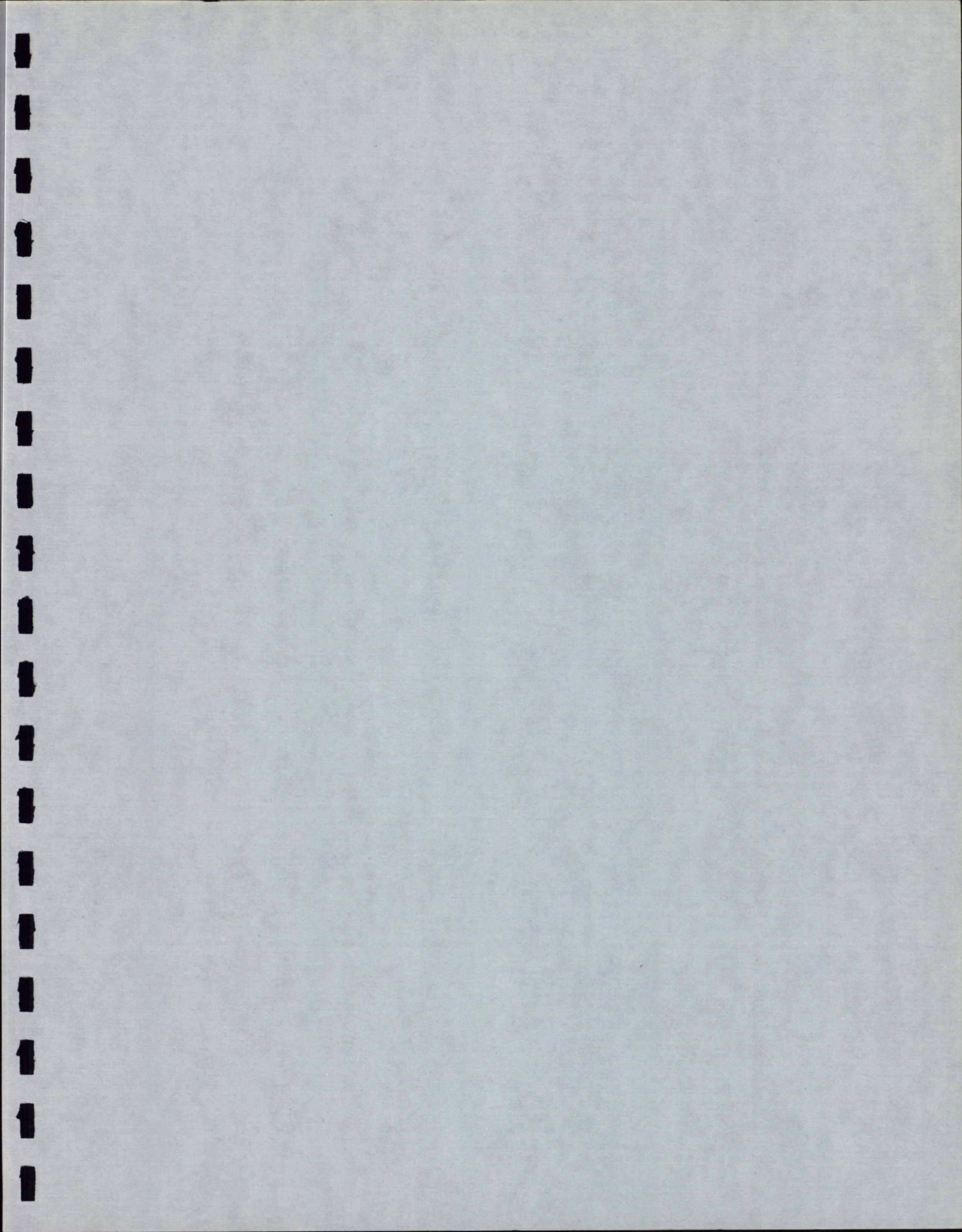
.Two site visits per year for an average duration of 2 days each for a 4-channel station.

.Two site visits per year for an average duration of 3 days for an 8-channel station.

Corrective maintenance

.Two failures per year are anticipated for each small station. Repairing time is estimated to be 2 days, including travelling time.

.Four failures per year are anticipated for each large station. Time to repair, including travelling, is also expected to be 2 days.



7. TECHNICAL EVALUATION OF THE MODELS

The purpose of this section is to review and discuss the technical characteristics of Models. In this context, the questions of prime importance are the following:

- a) interferences
- b) coverage
- c) use and availability of channels

7.1 INTERFERENCES

The potential for interferences can be broken down into two categories:

- a) interferences arising within the station
- b) interferences coming from external sources

7.1.1 Interferences arising within the station

Such interferences are basically the result of the presence of several signals with different modulations frequencies and power levels. The types of interferences likely to occur are:

- intermodulation
- image interference
- receiver desensitization

Our analysis confirms the risk of such interferences. But it also shows that these interferences can be controlled so that satisfactory multichannel operation is feasible.

In particular, the following cautions should be taken in finalizing the design of any rebroadcasting station:

- a) In the selection of frequencies to be assigned to a particular station one must avoid:

- frequencies which are multiple of each other;
- frequencies which are spaced one or two intermediate frequency apart;
- intermodulation products which correspond to one or more of the assigned frequencies .

- b) In the shielding of equipment

Even if intermodulation products do in fact fall within the band of a selected channel, they do not necessarily interfere, provided the resulting internal level is much lower than the channel signal level.

7.1 INTERFERENCES (cont'd)

7.1.1 Interferences arising within the station (cont'd)

b) In the shielding of equipment (cont'd)

Proper shielding of equipment ensures that such troublesome signals do not cause problems.

Previous experience has shown that chassis covers and closed cabinets with good electrical grounding is sufficient to prevent interference problems.

c) In the spacing of antennas

Spacing of antennas can be used to eliminate intermodulation interference and receiver desensitization in cases of off-air reception. Separation of only a few feet are sufficient for protection. It is, therefore, possible to stack several antennas on the poles or towers envisaged.

d) In the co-siting of AM, FM and TV stations

Co-siting of FM radio and TV does not present serious problems because of significant differences in antenna systems and site requirements, and the strong possibility of interference.

7.1.2 Interferences coming from external sources

Such interferences from outside the station may be caused by:

- metallic joints in nearby structures
- other channels operating in the area
- high voltage power lines
- reflection from nearby structures such as water, towers or metallic sheds.

The potential problems of interference due to the above causes can be greatly reduced by a careful choice of site for the rebroadcasting station. Keeping away from power lines, using directional antennas for transmitters and receivers and proper selection of frequencies will all help in significantly reducing the possibility of interferences from outside sources.

Interference from other stations is easier to predict in the case of FM and TV services. Tables 2, 3, 4 and 5 show total separation distance from nearby VHF stations to provide sufficient protection, based on co-channels and adjacent channel interference criteria.

7.1 INTERFERENCES (cont'd)

7.1.2 Interferences coming from external sources (cont'd)

Minimum distance between co-channel low VHF and high VHF stations are given respectively in tables 2 and 3, that for adjacent channel operation in these bands is given in tables 4 and 5. Table 6 shows minimum separation distance between 2 UHF co-channel stations.

In the case of AM radio, interference arising from distant stations is less predictable because it is most likely to come from the sky waves of far away transmitters. Choosing the higher signal contour in the calculation of AM coverage provides far better protection. For AM stations, considering an "average terrain" and a power less than 250 watts, the distances involved are in the order of 45 to 100 miles (11 and 14).

7.1.3 Other interference possibilities

The above interference considerations apply in general to all Models.

The Authors believe that interference problems could be solved for the low level broadcasting stations considered in this study. Nevertheless, an analysis of all frequencies and levels is necessary to ensure that, in fact, interfering intermodulation products will not be produced, and that frequency needs can be met. Use of TV channel 4 at microwave sites must be avoided to guard against interference with intermediate frequency used in microwave links.

It is also possible that interference may be produced at the household level in communities where multiple adjacent channels are used. Differences in received signal levels, mismatches in the receiving installations, and selectivity characteristics of television sets all contribute to such interference. Fortunately, this type of interference is not expected to be serious.

7.2 COVERAGE

7.2.1 AM coverage

The coverage contours of 0.1 mV/m; 1.0 mV/m and 4.0 mV/m were computed for various ground conductivities to take into account all types of terrain in Canada. Table 7 shows results for two frequency ranges: 1180 - 1240 KHz and 1430 - 1500 KHz and three levels of power: 50, 100 and 250 watts.

7.2 COVERAGE (cont'd)

7.2.2 FM and TV coverage

Coverage contours at signal levels of 500 $\mu\text{V}/\text{m}$ and grade B were computed respectively for FM radio and TV.

Table 9 shows the results in low VHF, FM, high VHF and UHF bands for the average terrain and three other typical terrain types encountered in Canada.

Also shown in Table 8 is a list of terrain types with their "terrain roughness factor" expressed by their equivalent 4 h in meters.

Table 10 gives an estimate of the coverage contour for a "passable" TV picture received at a household for the same four terrain types.

Table 11 gives similar results for low, medium and high groups of channels in the UHF band.

In the case of TV, coverage calculations were also conducted to estimate a grade C contour. This coverage corresponds to 6 dB better than average receiving installation utilizing outdoor antenna.

Table 12 gives these results for the low and high VHF bands and the UHF band.

Table 13 gives similar results for the low, medium and high groups of channels on the UHF band.

It should be noted that FCC (50,50) curves (9) were used to estimate coverage for terrain types encountered in Canada, for various radiated power levels, for various transmitting tower heights and different receiving installation arrangements.

In addition, typical cases were examined in greater detail, utilizing the Bullington method. Some examples were worked out to show what happens to the coverage distance for the flat earth case as obstructions are placed in the path between transmitter and receiver.

For example, the results obtained indicate that for a 100-watt ERP station at a 100' elevation, the coverage radius drops from 20 miles to 14 miles when a 100' obstruction is located at one mile from the transmitter. Multiple obstructions cut down the coverage radius even more and are also liable to produce ghosting.

7.3 FREQUENCY ALLOCATION

Existing rules and regulations covering frequency allocation for low power broadcasting stations in the AM, FM and TV bands were reviewed. The problem of spectrum congestion was studied and the requirements for physical separation of adjacent broadcasting stations were examined.

Finally, several examples of choices of channels for multichannel rebroadcasting stations were worked out, taking into consideration the interference problems.

7.3.1 AM channels

For AM radio, our Model is basically a class IV station, where power is limited to 250 watts. Six frequencies are already allocated for this service. AM frequencies are difficult to obtain in Southern Canada. There should be less difficulty for other areas. Re-use of frequencies for the 100 to 250-watt stations is possible in a 60 to 100-mile range radius from another station depending on ground conductivity and terrain.

7.3.2 FM channels

For FM radio, the stations of interest to our Study are basically low power FM types also. One may be concerned with class A stations in some cases where wider coverage is required. Choice of frequencies should not present a problem except near large metropolitan areas. Frequencies in the low end of the FM band should be avoided to prevent interference with TV channel 6. Distance for re-use of frequencies is as defined in Broadcast Procedure no. 14 (12).

7.3.3 TV channels

For TV application, the types of station of most interest are the low power classes of stations. As in the previous cases, frequencies are more difficult to obtain in Southern Canada.

In fact, the VHF band can even be considered saturated. In rural areas away from major metropolitan centers and from the South, VHF frequencies should be easier to obtain. Fortunately, UHF frequencies are generally available everywhere.

Distance separation for re-use of TV channels in adjacent stations are computed using DOC's rules and 30 dB S/N ratio at the protected contour.

A typical set of frequencies was selected for three stations forming a triangle. Stations A and B are 10 miles apart; station C is 18 miles from both stations, A and B.

7.3 FREQUENCY ALLOCATION (cont'd)

7.3.3 TV channels (cont'd)

The resulting choice of channels is as follows:

<u>STATION "A"</u>	<u>STATION "B"</u>	<u>STATION "C"</u>
2 or 3	7	2 or 3
4 or 5	9	4, 5 or 6
6	11	8
20	13	10
26	14	12
48	22	16
54	42	24
72	50	52
44	70	46
76	78	74

The above arrangement gives a variety of channels with considerable spacing in between. What may be more desirable is the use of channels which are more closely spaced to permit the use of lower cost solutions such as CATV equipment or UHF translator.

A block translator could take a group of closely spaced frequencies and rebroadcast them from a common antenna. This would be an attractive solution, since it would permit good frequency planning for covering rural areas with blocks of channels repeated at various intervals and would use common equipment. From our conversation with a manufacturer - Blonder-Tongue, V.I.A. - involved with such a scheme, it appears that block translator arrangements are possible but more development is required to eliminate interference problems which have arisen in some installations.

7.4 USE OF NON-STANDARD CONFIGURATION

Possible use of non-standard configuration was evaluated as a means of reducing the cost of the Models. The following conclusions were reached:

- a) The use of a CATV modulator feeding an antenna could provide a coverage radius from a half mile to 2 miles. Figure 8 shows the block diagram of CATV modulator arrangements.

7.4 USE OF NON-STANDARD CONFIGURATION (cont'd)

- b) Four channels could be combined into a CATV type of amplifier and radiated from a common antenna. Figure 9 shows the block diagram of such an arrangement. The above arrangements would have to be tested in laboratory and in the field to assess the picture quality and the potential interferences.

The use of a laboratory type of side band amplifier was also considered for the simultaneous amplification and transmission of several channels. This solution was finally rejected because of interference problems.

- c) Direct feed from a CATV system has also been considered. Block diagram for broadcasting of CATV feed is also shown in Figure 10. In such a configuration, the channels to be rebroadcasted could be selected from those available on cable. Locally generated programs could also be inserted. The use of a CATV wide band amplifier is also considered for feeding of several channels into one antenna. This type of configuration needs to be fully tested to ensure that it meets DOC and CRTC requirements.

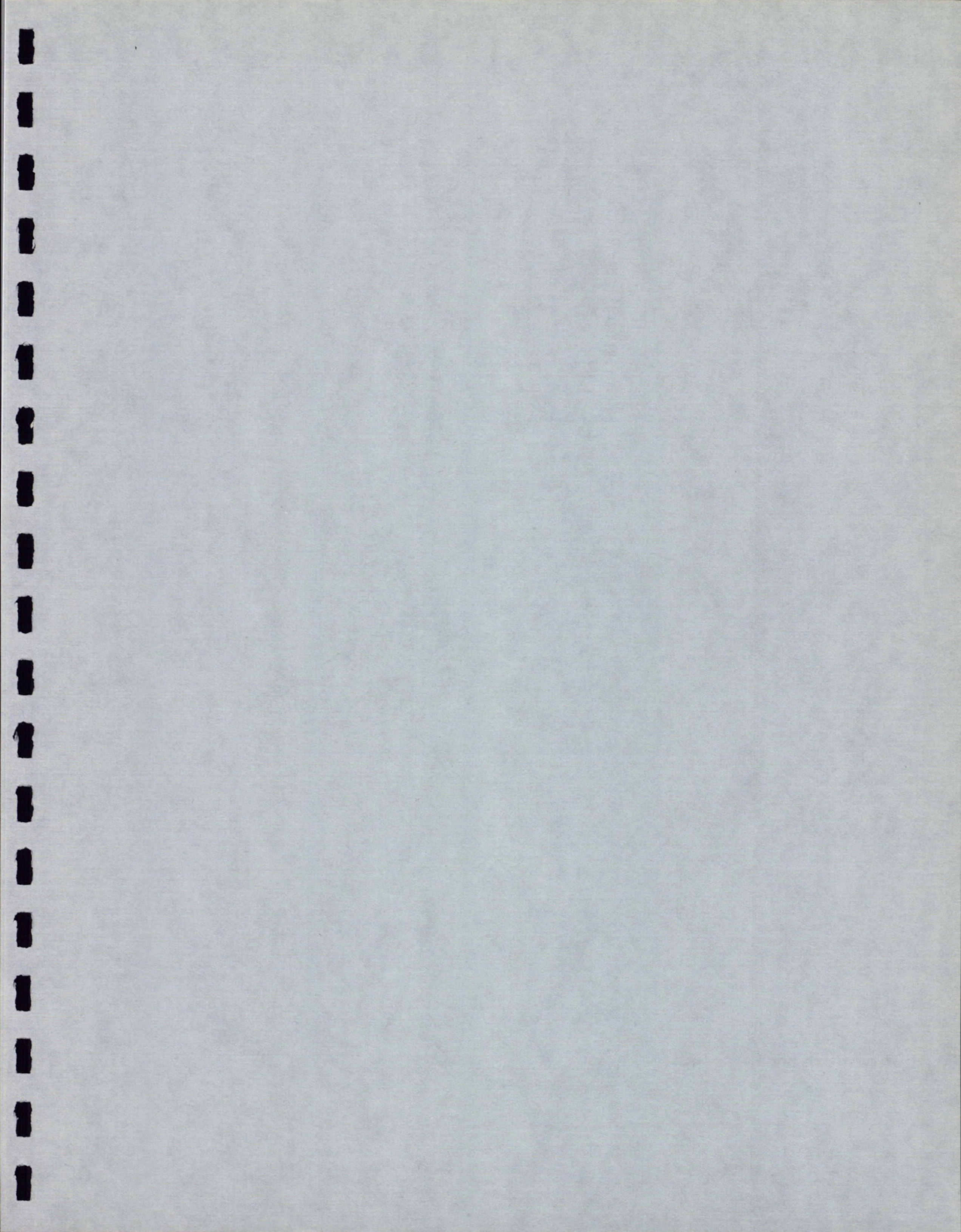
- d) Use of subcarrier on FM radio was also considered. Figure 11 shows the utilization of the frequency spectrum in two cases: FM stereo with one additional program, or FM mono with two additional programs could be carried. Special receiving equipment will be needed.

- e) A program spectrum of TV sound multiplex broadcasting using the FM-FM method is shown in Figure 12. One additional audio program could be carried for each TV channel. Such arrangement would necessitate a filter adapted to every household receiver to detect the additional program. A good application of this technique is the relay of this audio program using only one channel on a satellite or in a network of stations for reducing the importation cost of signals.

7.5 CONCLUDING GUIDELINES

The Models proposed are based on the use of low power broadcast type equipment. In view of the multiplexing of channels used in individual rebroadcasting stations and the potential sources of interference, it is recommended that prototype stations, built around these basic Model concepts, be designed, installed and fully tested in the field.

Of the non-standard configurations, block translators and use of sub-carrier on TV channels to carry additional audio programs both look promising and further research should be encouraged to favor their development in Canada.



8. POTENTIAL USE OF THE MODELS

In view of the different types of communities, terrain, climate, accessibility and coverage pattern, each Model may find more or less use in some particular region than in others. This section discusses some important Model parameters and local peculiarities related to the potential application of the proposed Models to the various geographic regions.

8.1 GEOGRAPHIC PECULIARITIES OF REGIONS

Other studies (1) (2) (3) have established that certain types of communities are found more frequently in some regions.

Consequently, a given Model will generally find a wider application in such regions where its basic features and performances are best suited to the geographic and demographic characteristics of these communities.

8.1.1 British-Columbia

In this region, we note the following: coastal lowlands, rugged coastal areas, mountains and valleys, thick vegetation and foot-hills. DEC

75% of the population is located in settlements. The rest lives in dispersed or sparsely areal types of communities.

The area of a settlement type of community may range from 0.4 to 5 square miles and it is spread over 2 or 3 miles. A rebroadcasting station Model with a 2-mile coverage would be generally appropriate for this application. However, odd shaped communities may require special antenna radiation patterns.

Actual observation shows that settlements are generally located in a valley or terrain which is practically flat with some houses possibly located on the side of a mountain. Similarly, on the coast, the same type of communities is close to sea level. Terrain roughness factor is in the order of 10 meters with variations up to 50 meters in some cases. Coverage of households on the side of a mountain will, in effect, be better than estimated, if the transmitter is located in the valley facing the side of the hill.

Although, terrain roughness may be 100 meters or more over several miles, for the short coverage distance involved with settlements, this can be ignored.

For the settlement type of communities, we consider Models having an effective radiated power of 10 watts or less, with a tower height of the order of 100', to be adequate.

8.1 GEOGRAPHIC PECULIARITIES OF REGIONS (cont'd)

8.1.1 British-Columbia (cont'd)

In the case of very dispersed or sparse areal types of communities, where coverage may extend for 10 miles in either direction, siting on a mountain top may prove most suitable, especially if there are existing facilities such as microwave repeaters or land mobile radio stations. A typical Model for such a case may have a 100 to 250-foot tower and radiation power between 100 and 1000 watts.

8.1.2 The Prairies: Alberta, Saskatchewan and Manitoba

The provinces of Alberta, Saskatchewan and Manitoba have been grouped together because of the similarity of their terrain characteristics. Terrain is flat with some sporadic hills. The Southern corner of Alberta has mountains and foothills. This area can be considered generally free of trees.

Between 50 and 75% of the households are grouped in communities which are fairly spread out. From maps (2), a coverage radius from 6 to 14 miles is required but with a rather large number of households at the periphery. This implies that some difficulties will be experienced in determining the boundary of community to be served. In fact, the choice of a coverage radius becomes a matter of judgement for each particular community.

To cover such communities, standard shelter Model will be generally more appropriate. The tower height and antenna radiation pattern will have to be tailored to each particular case.

The next most common type of communities in the Prairies is the settlement. Some 25% to 40% of households belong to this type. In this case, the coverage radius is around half a mile: the terrain roughness is about 10 meters. A low power Model of 10 watts or less and tower heights up to 100' will be satisfactory.

8.1.3 Ontario and Quebec

The type of terrain found in Ontario and Quebec consists mainly of flat land, rolling hills and hills with some mountains in the Southeastern part of Quebec. Terrain roughness factor can vary from 10 to 100 meters depending on the specific geographical area. Between 50% and 70% of households are grouped in fairly spread out communities of the lineal or dense areal types. The average coverage radius to be expected is of the order of 4 to 7 miles.

8.1 GEOGRAPHIC PECULIARITIES OF REGIONS (cont'd)

8.1.3 Ontario and Quebec (cont'd)

In general, the standard shelter Model with transmitter power of 10 to 250 watts and towers from 100' to 250' should prove adequate to cover these communities.

The remaining communities are classified as settlements and urbanizing types. Both types are found in equal portion in Ontario, while in Quebec, settlement type is more common than urbanizing.

For the last two types of communities, the pole mounted Model with power level of 100 watts or less and height of tower up to a maximum of 150' should be adequate.

8.1.4 The Maritimes: New Brunswick, Nova Scotia and Prince Edward Island

Terrain encountered in the Maritimes region varies from hills to plains with rugged coastal areas.

Households are grouped in two types of communities: lineal and settlement. In New Brunswick, the proportion is about 56% lineal and 44% settlement; in Nova Scotia the proportion is balanced with half of each type and in Prince Edward Island, 80% of the communities have a lineal distribution with only 20% for settlements.

A common occurrence in this region is a case of households grouped as a settlement with a number of houses located at the periphery. For our purpose, we can consider the communities as being grouped in a lineal fashion.

In general, the average radius of coverage will be in the order of 2 to 4 miles. A few particular cases may require coverage of about 8 miles.

To serve these two types of communities, the pole mounted Model is considered well suited for the settlement type and the standard shelter Model is applicable to the lineal type.

8.1.5 Newfoundland

The prevalent terrain characteristic is rugged coastal areas. Odd shaped communities where groups of houses follow the coast line or the perimeter of inlet are most likely. In such cases, the choice of sites and radiation patterns become very critical. It may even be found desirable to locate two rebroadcasting stations, at different ends of the same community, if sites on nearby hilltops are too difficult to access.

8.1 GEOGRAPHIC PECULIARITIES OF REGIONS (cont'd)

8.1.5 Newfoundland (cont'd)

About 76% of households are grouped in settlements and the remaining 24% are mainly found in lineal communities.

Settlements can be covered with the pole mounted Model of rebroadcasting stations of 10 watts or less and with a tower of 50' to 100'.

The lineal type of communities can be serviced by the standard shelter Model having a power level of the order of 250 watts and tower height of 250' or less.

8.2 SUMMARY

To summarize, communities of the settlement type are the most common. They prevail in British Columbia and Newfoundland, and they are also found in great number in all provinces. The pole mounted Model will generally find cost effective applications in these cases.

The lineal and sparse and dispersed types of communities are also found in all provinces, but are predominant in the Prairies, Ontario and Quebec. In general, the standard shelter Model will find more common use in these types of communities.

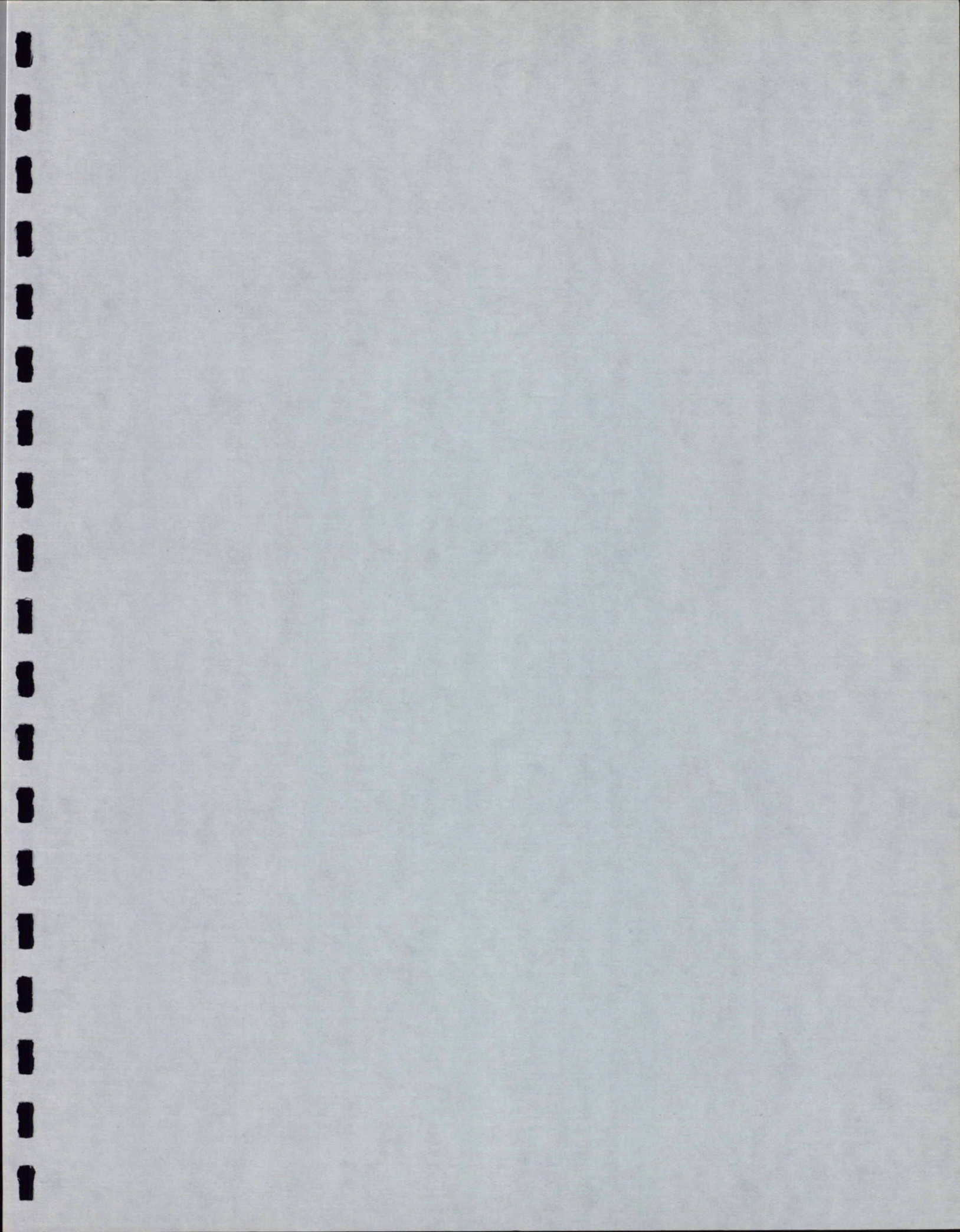
The specialized shelter Model and the existing housing Model can be considered as special applications of the standard shelter configuration. These two Models are tailored to tackle particular implementation problems which are likely to some communities.

For the purpose of developing the concept, antennas have been assumed to be yagis. But in actual situations, the choice of antennas should be based on individual requirements and coverage patterns.

PART III

COST OF REBROADCASTING STATIONS

DCB



PART III - COST OF REBROADCASTING STATIONS

9. COSTING OF MODELS

In Part III of this report, the costs of the proposed models are estimated in relation to several installation alternatives. The results are presented and discussed in the following sections.

In addition, Tables 15 to 30 present, in concise form, the cost elements for several variations of the configuration of each Model. The specific items which make them up are identified and costed in Appendix A for civil, electrical and mechanical works, and in Appendix B for the electronic equipment.

Furthermore, variations of basic Model costs and cost per household are shown in graphical form in Figures 13 to 18.

Variations of tower costs are also illustrated graphically by the parametric curves presented in Figures 20 to 23.

9.1 BASIC ASSUMPTIONS

Cost estimates of the Models were derived on the following basis:

- a) use of low cost broadcast equipment
- b) average parameters for terrain and for wind and ice loading
- c) electrical power available at the site
- d) easy access to site
- e) no land to purchase or lease

The estimates thus developed may be regarded as basic costs for the Models. In practice, detailed cost data found in Appendices A and B can be used to prepare more accurate cost estimates of a specific station, when local conditions are different from those used to establish the basic costs.

9.2 CAPITAL COST ELEMENTS

9.2.1 Civil, electrical and mechanical works

Part A of Table 15 lists, in detail, the cost elements for a 1-watt pole mounted Model. Table 17 lists similar costs for a standard shelter Model.

These two Models may be considered as examples of cost calculation using data given in Appendix B. But the result of such calculations are then directly entered in the first row "Civil, Electrical and Mechanical Works" of the following Cost Summary Tables 18 to 29 which present the basic cost estimated for several representative configurations of the Models.

9.2.2 Engineering, installation and supervision

Costs for engineering, installation and supervision include: planning; design, preparation of plans and specifications; selection of channels; study of interference; choice of site; selection of Model, antennas and equipment; supervision of installation and installation of electronic equipment. However, costs relative to the installation and construction of buildings and towers, including their related services, are part of the civil, electrical and mechanical costs.

Table 16 gives an estimate of the engineering, installation and site supervision costs associated with each of the four basic Models. These costs which range from \$17,000 for a 4-channel station using a pole-mounted Model to \$38,000 for an 8-channel medium power station in a standard shelter Model. In each specific case, the above estimates will have to be adjusted to take into account local particularities.

A reduction of \$2,000 per channel has been allowed for the calculation of engineering and installation costs of the electronic equipment, wherever the number of channels is fewer.

The corresponding costs are entered in the second row "Engineering and Site Supervision" of the Cost Summary Tables.

9.2.3 Electronic equipment

Part B of Table 15 shows the estimated costs of electronic equipment for a 1-watt pole-mounted Model. These costs were derived from the detailed cost data appearing in Appendix B for the electronic equipment. In the other cases, the resulting cost is entered directly in the third row "Electronic Equipment" of the Cost Summary Tables.

9.3 RECURRING COST ELEMENTS

9.3.1 Maintenance costs

Based on the maintenance philosophy presented in section 6.4, we estimate the maintenance costs as follows:

1. A local contractor is hired for the Civil, Electrical and Mechanical maintenance, at the following annual costs for standard shelter Models:

-Site	\$ 300.
-Tower (check guy wires tension twice a year and repaint tower every 5 years)	1,500.
-Building	<u>600.</u>
	<u>\$ 2,400.</u>

For a pole mounted Model with 80' guyed pole, the maintenance cost is taken as \$2,000 annually. If the pole is short and not guyed, only \$200 per year could be allowed for minor site maintenance.

2. Maintenance costs for the electronic are estimated at:

Small station, 4 channels, more than 10 watts

-8-man/day at \$200.	\$ 1,600.
-4 trips at a cost of about \$150 each	600.
-spare parts at \$150 per channel	<u>600.</u>
	<u>\$ 2,800.</u>

For 10-watt or less installations, 4 channels

-6-man/day at \$200.	\$ 1,200.
-3 trips at a cost of about \$150 each	450.
-spare parts at \$50 per channel	<u>200.</u>
	<u>\$ 1,850.</u>

Larger station, 8 channels, more than 10 watts

-14-man/day at \$200	\$ 2,800.
-6 trips at a cost of about \$150 each	900.
-spare parts at \$150 per channel	<u>1,200.</u>
	<u>\$ 4,900.</u>

9.3 RECURRING COST ELEMENTS (cont'd)

9.3.1 Maintenance costs (cont'd)

Annual parts allowance for medium power stations add \$300 per VHF transmitter and \$1,000 per UHF transmitter.

Annual parts allowance for higher power stations (1 KW) add \$2,000 per VHF transmitter and \$2,500 per UHF transmitter.

9.3.2 Operating costs

Operating costs include only the consumption of electrical power needed to operate the stations. The following estimates are based on a figure of \$200 per KWh per annum:

TYPE OF MODELS	Estimated Power Load	Estimated Annual Cost
-Pole mounted: 1 watt	1.0 KW	\$ 200.
10 watts	1.0 KW	\$ 200.
each additional channel	0.1 KW	\$ 20.
-Specialized shelter: 1 watt	1.0 KW	\$ 200.
10 watts	1.5 KW	\$ 300.
each additional channel	0.1 KW	\$ 20.
-Standard shelter:		
medium power, 4 channels	15.0 KW	\$ 3,000.
medium power, 8 channels	30.0 KW	\$ 6,000.

9.4 TOTAL COSTS OF FM AND TV MODELS

9.4.1 Cost summaries of typical configurations

Detailed capital costs and recurring yearly costs are given at the end of this report in the Cost Summary Tables 18 to 30.

In brief, these costs for 4 TV and 2 FM channel Models are:

9.4 TOTAL COSTS OF FM AND TV MODELS (cont'd)9.4.1 Cost summaries of typical configurations (cont'd)

DESCRIPTION OF MODELS	Capital Cost	Recurring Cost
Model no. 1: 1-watt pole mounted Model, 2-mile coverage, high band VHF (Table 18)	\$ 61,000	\$ 4,050
Model no. 1: 10-watt pole mounted Model, 4-mile coverage, high band VHF (Table 19)	\$ 74,000	\$ 4,150
Model no. 2: standard shelter Model, 8-mile coverage, high band VHF (Table 20)	\$ 179,000	\$ 9,100
Model no. 2: standard shelter Model, 14-mile coverage, high band VHF (Table 21)	\$ 253,000	\$ 11,500
Model no. 3: 1-watt specialized shelter Model, 2-mile coverage, high band VHF (Table 22)	\$ 59,000	\$ 2,450
Model no. 4: 1-watt existing housing Model, 2-mile coverage, high band VHF (Table 23)	\$ 50,000	\$ 2,450
Model no. 1: 1-watt pole mounted Model, 2-mile coverage, UHF band (Table 24)	\$ 88,000	\$ 4,050
Model no. 2: standard shelter Model, 4-mile coverage, UHF band (Table 25)	\$ 152,000	\$ 5,150
Model no. 2: standard shelter Model, 8-mile coverage, UHF band (Table 26)	\$ 298,000	\$ 12,400
Model no. 2: standard shelter Model, 14-mile coverage, UHF band (Table 27)	\$ 389,000	\$ 14,500
Model no. 3: 1-watt specialized shelter Model, UHF band (Table 28)	\$ 87,000	\$ 2,450
Model no. 4: 1-watt existing housing Model, UHF band (Table 29)	\$ 78,000	\$ 2,450
Model no. 1: pole mounted Model, make shift arrangement (CATV type of equipment) (Table 30)	\$ 43,000	\$ 4,000

9.4 TOTAL COSTS OF FM AND TV MODELS (cont'd)

9.4.2 Amortization of capital costs

The capital costs given in Tables 18 to 30 were amortized over a period of 15 years. Life of the civil works can be taken to be 20 years. However, because life of equipment is only 15 years, this was used as the amortization period.

Interest rate of 12% per year compounded semi-annually was used to calculate the annual amortization costs, also shown in the same Tables.

9.4.3 Total annual costs

Also appearing in Tables 18 to 30 is the total annual cost for each model configuration which is obtained by adding the equivalent annual cost of capital and annual recurring costs. Corresponding percentages of capital costs and recurring costs in terms of total annual costs are shown in the same Tables.

9.5 COSTS OF AM RADIO INSTALLATIONS

Anticipated capital costs for AM radio installations using the 50-watt and the 250-watt Models were established at \$22,000 and \$39,000 respectively.

The results appear in Table 31. However, it should be noted that these cost estimates are based on a simple long wire antenna arrangement. If a more efficient antenna and an extensive ground system are required, the cost of the 250-watt station could easily increase to about \$90,000.

9.6 GRAPHICAL PRESENTATION OF COSTS

The various cost estimates developed in the course of this study have been presented in graphical form for ease of interpretation:

- Figure 13 shows the basic Model costs in relation with the number of channels for stations operating in the VHF high band.
- Figure 14 shows the station annual cost per household as a function of the number of households in the coverage area for several configurations of stations operating in the VHF high band.
- Figure 15 shows in the same manner the basic Model costs in relation with the number of channels of stations operating in UHF band.
- Figure 16 shows the station annual cost per household as a function of the number of households in the coverage area for the same station configurations as in the UHF band.

9.6 GRAPHICAL PRESENTATION OF COSTS (cont'd)

-Figure 17 shows the annual cost per household in relation with the number of households for a 1-watt pole mounted Model.

-Figure 18 shows the incremental costs for 2 FM channels in relation with the number of households.

-Figure 19 shows the relationship between the number of households and the annual cost per household for one AM radio channel.

9.6.1 Discussion of VHF Model costs

Figure 13 gives the annual cost which a given community would have to pay for the configuration and the number of channels they require. The results are summarized as follows:

CONFIGURATION OF MODELS	ANNUAL COST	
	First TV Channel	Each additional TV channel
Existing housing (1-watt Model)	\$ 5,000	\$ 1,000 up to 7*ch.
Specialized shelter (1-watt Model)	\$ 7,000	\$ 1,000 up to 4 ch.
Pole mounted (2-mile coverage)	\$ 8,000	\$ 1,000 up to 4 ch.
Pole mounted (4-mile coverage)	\$ 8,500	\$ 1,500 up to 4 ch.
Standard shelter (8-mile coverage)	\$ 15,500	\$ 5,000 up to 7*ch.
Standard shelter (14-mile coverage)	\$ 20,000	\$ 7,200 up to 7*ch.

* Adjacent Channel Restrictions

The lowest cost occurs in the case where a suitable building is made available at no cost to install the station in the community to be served. The cost increases as one move to other types of installation and greater coverage. Cost are based on a mix of low band and high band VHF channels.

Figure 14 shows the station annual cost per household in relation with the size of community expressed by the number of households in the coverage area.

9.6 GRAPHICAL PRESENTATION OF COSTS (cont'd)

9.6.1 Discussion of VHF Model costs (cont'd)

Using a figure of \$100 per year per household, we see that communities of less than 100 households could only pay for 1-watt station installed in an existing building.

Communities having more than 150 households, within a 2 or 4 mile radius, could easily afford a 4 TV channel pole-mounted Model.

Communities requiring an 8-mile coverage would need to have at least 300 households sharing the cost of a 4-channel rebroadcasting station and those having a 14-mile coverage requirements would need at least 400 households for the same station.

Communities counting more than 800 households within a 14-mile radius could afford an 8-channel station.

9.6.2 Discussion of UHF Model costs

As in paragraph 9.6.1 above, the same results are presented, but for UHF channels. Thus, Figure 15 shows the annual cost to the community of the basic Models operating in the UHF band in relation to the number of channels needed.

The results are summarized as follows:

CONFIGURATION OF MODELS	ANNUAL COST	
	First TV Channel	Each additional TV channel
Existing housing (1-watt Model)	\$ 6,700	\$ 1,400 up to 8 ch.
Specialized shelter (1-watt Model)	\$ 8,500	\$ 1,800 up to 4 ch.
Pole mounted (2-mile coverage)	\$ 9,000	\$ 1,800 up to 4 ch.
Standard shelter (4-mile coverage)	\$ 13,000	\$ 4,000 up to 8 ch.
Standard shelter (8-mile coverage)	\$ 23,000	\$10,100 up to 8 ch.
Standard shelter (14-mile coverage)	\$ 25,500	\$12,700 up to 8 ch.

9.6 GRAPHICAL PRESENTATION OF COSTS (cont'd)

9.6.2 Discussion of UHF Model costs (cont'd)

Again, lowest cost installations are those made in an existing building. For standard shelter installation having 14-mile coverage and more than 4 channels, additional costs may be incurred for a stronger tower required to support additional higher power antennas.

Figure 16 presents results similar to those presented in Figure 14 but for stations operating in the UHF band.

We note here that UHF installations are more costly for the same coverage. Consequently, more households are required within a given coverage area to reach the same target prices per household.

For example, what 100 households could pay for at \$100 per year, using high band VHF, would require 140 households in UHF band for the same service.

9.6.3 Discussion of pole mounted Model costs

Figure 17 shows the annual cost per household of 1 and 4 TV channels 1 watt pole mounted Model operating either in high band VHF or UHF. These configurations are intended for smaller communities. As an example, we note that for a 4 TV channel station, the annual cost per household is 40% higher in UHF than in VHF.

9.6.4 Discussion of radio service costs

a) FM radio service

In the case of FM radio, we have seen that the equipment will be installed using the same basic installation as used for TV. Therefore, Figure 18 shows incremental costs for 2 FM channels applicable to various Models.

Assuming an average of 3.5 persons per household, the same curves can be used, with two different scales, the first per household, the second per person, to estimate for comparison purpose, this annual incremental cost on either basis.

b) AM radio service

Because co-siting of AM installation with FM and TV stations is not recommendable, the total annual cost of AM radio Models no. 5 and 6 presented in section 9.5 above and Table 31 includes the shelter as well as the electronic equipment costs.

Figure 19 plots the annual cost for one AM radio channel delivered by the 50-watt and the 250-watt Models.

9.7 PARAMETERS USED IN ESTABLISHING COSTS

The cost estimates for each Model were established in accordance with the basic assumptions already discussed in section 9.1. Nevertheless, those general assumptions were not sufficient to develop usable estimates and, therefore, the following parameters were also defined for the basic Models. In addition, interested readers will find further details on cost breakdowns and variations to basic Model costs in Appendices A and B.

9.7.1 Model no. 1 - Pole mounted Model

The parameters used were:

- terrain roughness factor: $\Delta h = 10$ meters
- grade B coverage radius about 2 miles
- high band VHF channels used for transmission
- installation meets DOC broadcast standards
- wind pressure: 13 psf
- ice loading: 1" thickness
- pole height: 80'
- local resident is responsible for guarding the station.

9.7.2 Model no. 2 - Standard shelter Model

For the standard shelter Model, two estimates were developed to provide a coverage radius of 8 miles and the other of 14 miles. The parameters used were:

- terrain roughness factor: $\Delta h = 10$ and 50 meters
- electrical power available within 200'
- installation meets DOC broadcast standards
- 40' safety fence around the tower
- guyed tower 150' for the 8-mile coverage
- guyed tower 250' for the 14-mile coverage
- ice loading: $\frac{1}{2}$ " or 1" thickness
- wind pressure: 10 psf

9.7.3 Model no. 3 - Specialized shelter Model

The specialized shelter Model is considered installed beside an existing road to cover a community in a valley below.

The particular assumptions made were:

- minor site clearance
- 40' safety fence

9.7 PARAMETERS USED IN ESTABLISHING COSTS (cont'd)

9.7.4 Model no. 4 - Existing housing Model

The existing housing Model envisaged is the one where suitable space can be provided in a building, such as a school or other few buildings having several floors, strategically located from a coverage point of view.

9.8 ENVIRONMENTAL FACTORS

9.8.1 Coverage

In general, the cost of a station increases with the required coverage radius. To maintain costs at a reasonably low level, a combination of design criteria including transmitter power, tower height and good receiving installation must be worked out for each community.

9.8.2 Channels choice

TV and FM signals obey the law of electromagnetic propagation, which means that the higher the frequency, the smaller the coverage will be for equal power levels. When the channels are close together, the difference of frequencies does not significantly affect the extent of the coverage. Hence, all channels in the low band VHF give, in practice, the same coverage and similarly for the high band VHF channels. However, the channels in the low end of the UHF band provide better coverage than those in the upper end of the UHF band.

9.8.3 Terrain

The roughness of the terrain has the effect of reducing the effective tower height and, consequently, the coverage radius.

For very rugged mountainous terrain, coverage becomes less predictable. Here signals may propagate for long distances down the valleys due, in large part, to multiple reflections from adjacent peaks. Vegetation also causes obstruction to the propagation path. Stations installed in such an environment must be carefully designed, taking in consideration the specific characteristics of each site.

9.8.4 Climate

Ice accumulation has the effect of detuning Yagi antennas, and therefore reduces the coverage. De-icers or especially designed broadband antennas are recommended in areas of heavy ice accumulation.

9.8 ENVIRONMENTAL FACTORS (cont'd)

9.8.5 Accessibility

The easier the access to a site, the lower cost. This is true for both installation and maintenance costs. A remote site may require site clearing, building an access road, hauling material and equipment by truck or by helicopter.

In addition, primary electrical power may not be readily available or independent power generators may be needed. An existing remote site where all these facilities are already available may be much more economical, since cost can be shared with other users. In general, a site in the community itself is likely to be more economical for installation and servicing.

9.9 COSTS OF UHF MODELS

The use of UHF channels results in higher costs for the Models. The prime reason is the fact that a higher radiated power must be delivered in order to achieve the same coverage in UHF than in VHF.

The increase in effective radiated power can be achieved by the use of more powerful transmitter or higher efficiency antennas and transmission lines. DC:

Allowance was made in our estimates for more powerful transmitter to provide the same coverage in the UHF band as that achievable in the VHF high-band. This provides a certain margin of flexibility in selecting antennas, transmission lines and combiners.

In brief, the increase in cost for the UHF Models is caused by the following factors:

- a) equipment is more costly because of the higher power required for a given coverage;
- b) more space is needed for the equipment. Sometimes this might require the use of a larger building. For example, the 20-watt UHF transmitter becomes too large for a pole mounted Model and a standard shelter must be used;
- c) spares for the UHF equipment are more costly;
- d) higher power drain is required.

Tables 24 to 29 summarize the cost applicable to 6 different Models in the UHF band.

9.10 COST PROJECTIONS

In an attempt to develop some preliminary guidelines and reference points for the estimation of the overall implement cost of rebroadcasting networks on a nation-wide or local basis, this section presents a tentative estimate of national average costs of rebroadcasting distribution followed by a brief discussion of regional factors affecting global costs in any particular areas.

9.10.1 Global costs and national averages

Global annual costs were established using the total annual cost of the proposed Models which is most likely applicable to the types of communities listed in Table 1. The results are summarized as follows:

a) 4 TV plus 2 FM programs

-Model no. 1 (2 mi. for settlement)	3,256 @ \$12,712:	\$41,390,272
-Model no. 1 (4 mi. for urbanizing)	276 @ \$14,658:	\$ 4,045,608
-Model no. 2 (8 mi. for lineal)	398 @ \$34,518:	<u>\$13,738,164</u>
		\$59,174,044

Considering that these three types of communities count about 1,186,000 households, the average per household is rounded to \$50 per year for this group.

-Model no. 2 (8 mi. for dense areal)	1,153 @ \$34,518:	\$39,799,254
-Model no. 2 (14 mi. for sparse)	1,960 @ \$47,426:	\$92,954,960
-Model no. 2 (8 mi. for dispersed)	326 @ \$34,518:	<u>\$11,252,868</u>
		\$144,007,182

With only 530,000 households grouped in these two types of communities, the average per household is rounded to \$272 per year.

9.10 COST PROJECTIONS (cont'd)

9.10.1 Global costs and national averages (cont'd)

b) 8 TV plus 2 FM programs

-Model no. 4 (2 mi. for settlement)	2,900 @ \$13,692:	\$ 39,706,800
-Model no. 2 (8 mi. for settlement)	356 @ \$54,632:	\$ 19,448,992
-Model no. 2 (4 mi. for urbanizing)	276 @ \$54,362:	\$ 15,003,912
-Model no. 2 (8 mi. for lineal)	389 @ \$54,362:	\$ <u>21,146,818</u>
		\$ 95,306,522

With the same 1,186,000 households to be served, the average cost for delivering 8 TV plus 2 FM programs over-the-air reaches \$80 per household in this group.

-Model no. 2 (8 mi. for dense areal)	1,153 @ \$54,362:	\$ 62,679,386
-Model no. 2 (14 mi. for sparse areal)	1,960 @ \$76,792:	\$150,512,320
-Model no. 2 (8 mi. for dispersed)	326 @ \$54,362:	\$ <u>17,722,012</u>
		\$230,913,718

With the 530,000 households in this group, the average per household is rounded to \$436 per year.

The above results are only indicative since large local variations may occur.

9.10.2 Regional effects on Model costs

In a first attempt to evaluate the effect on the cost of Models due to regional conditions, the methodology set below was followed.

Correction factors were derived, based on the following variables:

9.10 COST PROJECTIONS (cont'd)

9.10.2 Regional effects on Model costs (cont'd)

- a) ice and wind loads
- b) construction cost differentials
- c) electronic equipment transportation costs
- d) other labour and trade costs
- e) energy costs

For specific areas such as the Southern coast of Newfoundland, the East coast of Labrador and the coast of British Columbia, the exceptions might be quite common, since access in certain places is only possible by helicopter or by boat, under special arrangements with local inhabitants. For such sites, higher installation and maintenance cost would have to be allowed for special transportation charges.

Assuming that the factors considered add-up, we note the following variations of the Model costs compared to Ontario and Quebec.

In the Maritimes and the Prairies, both capital and operating costs are around 1% higher.

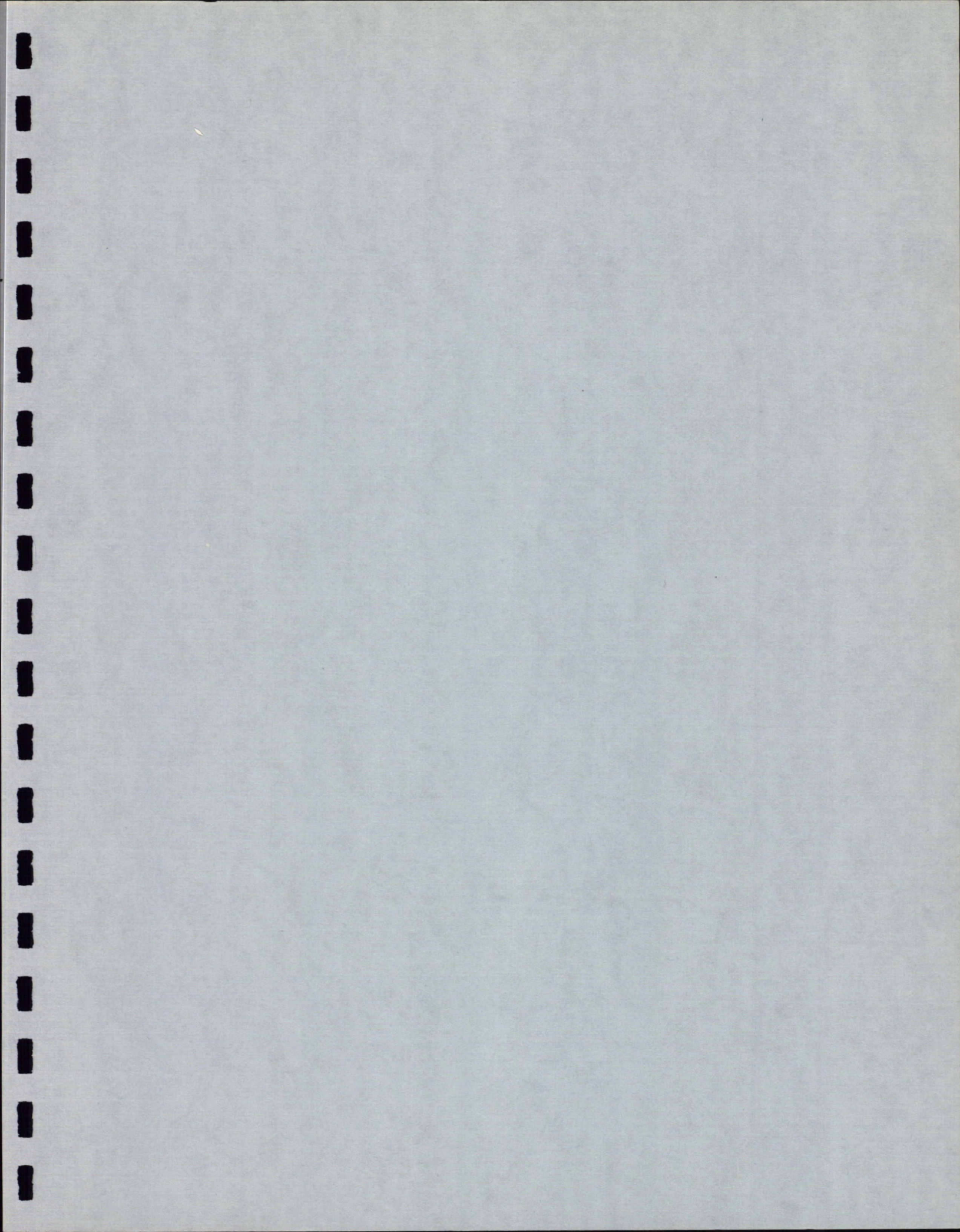
In Newfoundland, the capital costs are increased by 2% to 5% and the operating costs by 6% to 10%.

In British Columbia, the corresponding percentages are established to 4% and 6% respectively.

In conclusion, it appears that these variations are small compared to the accuracy of the estimates that the basic cost of Models is practically the same in all regions.

However, it is to be noted that the correction factors proposed are very small compared to the accuracy of any estimates at this preliminary stage.

The final choice of Model and equipment, as well as local conditions, may result in actual costs considerably different from those estimated in this report.



10. COMPARATIVE ANALYSIS OF COSTS

The cost estimates which are discussed in Chapter 9 are the basic costs applicable to each Model. In this chapter, those costs are reviewed and compared to alternative solutions.

10.1 POSSIBILITIES OF COST REDUCTION

10.1.1 Standard broadcast installations

The costs of the Models were based on the use of standard equipment normally available off the shelf. Configurations were developed using a minimum number of equipment selected from the low cost category.

In this respect, these costs can be considered as minimal. Nevertheless, limited savings can still be achieved in specific cases where certain design parameters can be optimized.

One way of achieving cost savings is to use a somewhat limited coverage for a community and have households located outside the prime service area use outdoor antennas to receive an adequate signal.

Such a decision may be economical when the number of houses lying at the periphery is small compared to the whole community. As a guide, one may say that this approach is worth some considerations as soon as the marginal cost of providing adequate service to one or several houses at the periphery of a community exceeds the cost of providing a standard consumer receiving installation in these houses. If the householder installs it himself, the cost of such an equipment is estimated at about \$300 per house.

Finally, capital cost reductions may be envisaged at two other levels:

- a) For the civil, electrical and mechanical engineering, a set of standardized drawings and specifications could be prepared for each Model. These drawings and specifications could then be adapted with a minimum of cost by communities or individual operators and used to contract for the supply and installation of the material in their particular environment. The cost for the preparation of a set of such drawings could amount to about \$20,000.
- b) Similarly, important electronic equipment savings could be achieved if communities within the same region retain jointly engineering services from the same firms and order together, at the same time, their equipment from common suppliers.

10.1 POSSIBILITIES OF COST REDUCTION (cont'd)

10.1.2 Non-standard installations

a) CATV type of equipment

In an attempt to reduce costs and to offer economical solutions to small communities, several arrangements using CATV modulators and amplifiers were studied (Figures 8, 9 and 10).

The costs of such an installation using the pole-mounted Model are presented in Table 30.

We note that for a 4-channel station, the total capital cost is \$31,000 compared to \$47,000 for a 1-watt pole-mounted Model using broadcast equipment.

The counterpart of this lower cost is that the CATV equipment has a limited power output and necessarily a reduced coverage. In addition, CATV equipment was not originally designed to operate in such a manner and technical difficulties could be encountered. However, this indicates that less expensive television technology is available. Further work and experimentation in that direction may, in fact, lead to the development of cheaper equipment and more effective packaging techniques for rebroadcasting applications.

b) TV multiplexing

An alternate method of delivering radio programs is to transmit on a subcarrier an extra audio channel on each television channel.

Additional equipment cost is of the order of \$4,000 per channel. At such a price, this alternative is not attractive for a 2-mile coverage station, but when compared to \$11,000 for a standard FM channel in an 8-mile coverage station, it may be considered cost-effective. However, in this case, every household wishing to receive these channels would need additional equipment which is not the case with a standard.

10.2 COMPARISON WITH ALTERNATIVE SIGNAL DISTRIBUTION METHODS

10.2.1 CATV installations

The rate charged for CATV services in small communities varies from \$4 to \$10 per month. The corresponding annual cost of about \$50 to \$120 gives an indication of the amount of money people might be ready to spend for television services in Rural Canada.

10.2 COMPARISON WITH ALTERNATIVE SIGNAL DISTRIBUTION METHODS (cont'd)

10.2.1 CATV installations (cont'd)

Previous discussion has shown that a 4-channel TV rebroadcasting station can be provided for about \$50 per household per year.

Assuming that program feed can also be provided for a same amount, we arrive at the conclusion that 70% of the communities in Rural Canada can support a rebroadcasting station at a cost comparable to what they would pay for CATV services.

10.2.2 Satellite broadcasting

Sometime in the future, transmission of TV signals from satellite for direct home reception will be available.

In the early 80's it is estimated that an initial investment of about \$500 by the householder for a satellite receiving installation and a recurring service charge of \$20 per year are realistic. At that time, direct pick-up of TV signals from satellites could be considered for the population living in sparse or dispersed communities which represent 30% of the total rural population. In fact, this cost is far lower than the \$268 per household per year which was estimated to provide broadcast services to sparse and dispersed communities.

10.3 CONCLUDING OBSERVATIONS

In this study, we developed 4 Models of multichannel rebroadcasting stations capable of providing television and FM radio services to communities in Rural Canada. The proposed Models were costed-out and evaluated from both technical and economical points of view.

A rapid analysis of demographic data seems to indicate that about 70% of households in rural areas could be provided with rebroadcasting stations at costs comparable to what they would pay for CATV services.

Direct pick-up of signals from satellites appears to be cost-effective for the remaining 30% of households in the very low density areas.

The choice between a rebroadcasting station and a CATV system will require a case by case analysis of the advantages and disadvantages of both alternatives in relation with their effective costs for a single or a group of communities in a given region.

T A B L E S 1 T O 3 1

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TABLE 1
SIZE OF COMMUNITIES IN RURAL CANADA

TYPE OF COMMUNITIES	NUMBER OF HOUSEHOLDS	AREA OCCUPIED SQ. MI.	HOUSEHOLD PER SQ. MI.	ESTIMATE OF NUMBER OF CELLS	AREA OF CELLS SQ. MI.	RADIUS OF CELL* SQ. MI.	HOUSEHOLDS PER CELL
1. Urbanizing	131,377	2,823	46.5	276	10.23	1.8	476
2. Lineal distribution	489,493	41,643	11.8	398	104.64	5.8	1,230
3. Dense areal distribution	235,215	54,156	4.3	1,153	46.97	3.9	204
4. Sparse areal distribution							
.Typical section A	172,347	76,052	2.3	1,222	62.22	4.5	141
.Typical section B	66,976	142,169	0.5	644	220.76	8.4	104
.Typical section C	<u>19,902</u>	<u>6,953</u>	<u>2.9</u>	<u>94</u>	<u>73.72</u>	<u>4.9</u>	<u>211</u>
TOTAL	<u>259,225</u>	<u>225,174</u>	<u>1.2</u>	<u>1,960</u>			<u>132</u>
5. Very dispersed	33,860	71,875	0.5	326	220.76	8.4	104
6. Settlement	566,476	12,502	45.3	3,256	3.84	1.1	174

* For simplicity, a circular distribution of households is assumed. But, in practise, a variety of shapes is found.

TABLE 2
SEPARATION BETWEEN TWO CO-CHANNELS - LOW VHF
 (Based on a protection ratio of 30 dB at the "B" contour)

Existing Station ERP (watts)	EHAAT	Distance (mi) to protected contour 47dBu *	Planned Station ERP (watts)	EHAAT	Distance (mi) to 17 dBu contour *	Total Separation required (mi)
1 W	100'	2.5	1 W	100'	13.0	15.5
10 W	100'	5.0	10 W	100'	23.0	28.0
100 W	100'	8.0	100 W	100'	36.0	44.0
100 W	300'	13.0	100 W	300'	50.0	63.0
100,000 W	1000'	57.0	100 W	300'	50.0	107.0
100,000 W	1000'	57.0	1,000 W	1000'	86.0	143.0
100,000 W	1000'	57.0	10,000 W	1000'	102.0	159.0

* Distances taken from BP. 5

TABLE 3
SEPARATION BETWEEN TWO CO-CHANNELS - HIGH VHF
 (Based on a protection ratio of 44 dB at the "B" contour)

Existing Station ERP (watts)	EHAAT	Distance (mi) to protected contour 56dBu *	Planned Station ERP (watts)	EHAAT	Distance (mi) to 12 dBu contour *	Total Separation required (mi)
1 W	100'	1.7	1 W	100'	20.0	21.7
10 W	100'	3.0	10 W	100'	31.0	34.0
100 W	100'	5.0	100 W	100'	43.0	48.0
100 W	300'	9.0	100 W	300'	55.0	64.0
325,000 W	1000'	52.0	100 W	300'	55.0	107.0
325,000 W	1000'	52.0	1,000 W	1000'	85.0	137.0
325,000 W	1000'	52.0	10,000 W	1000'	97.0	151.0

Note: All separations based on propagation over an average terrain

* Distances taken from BP. 5

TABLE 4
SEPARATION BETWEEN TWO LOW-VHF ADJACENT CHANNELS.
(Based on a protection ratio 30 dB at the "B" contour.)

Existing Station ERP (watts) Low VHF	EHAAT	Distance (mi) to protected cont. (47dBu) *	Planned Station ERP (watts) adjacent chann.	EHAAT	Distance (Mi) to 17 dBu contour *	Total Separation required (Mi)
1 W	100'	2.5	1 W	100'	13.0 mi	15.5
10 W	100'	5.0	10 W	100'	23.0 mi	28.0
100 W	100'	8.0	100 W	100'	36.0 mi	44.0
100 W	300'	13.0	100 W	300'	50.0 mi	63.0
100,000 W	1000'	57.0	100 W	300'	50.0 mi	107.0
100,000 W	1000'	57.0	1,000 W	1000'	86.0 mi	143.0
100,000 W	1000'	57.0	10,000 W	1000'	102.0 mi	159.0

* Distances taken from BP-5

TABLE 5
SEPARATION BETWEEN TWO HIGH-VHF ADJACENT CHANNELS.
(Based on a protection ratio of 30 dB at the "B" contour.)

Existing Station ERP (watts) High VHF	EHAAT	Distance (mi) to protected cont. (56dBu) *	Planned Station ERP (watts) adjacent chann.	EHAAT	Distance (Mi) to 26 dBu contour	Total Separation required (Mi)
1 W	100'	1.7	1 W	100'	9.0 mi	10.7
10 W	100'	3.0	10 W	100'	17.0 mi	20.0
100 W	100'	5.0	100 W	100'	26.0 mi	31.0
100 W	300'	9.0	100 W	300'	40.0 mi	49.0
325,000 W	1000'	52.0	100 W	300'	40.0 mi	92.0
325,000 W	1000'	52.0	5,000 W	1000'	78.0 mi	130.0
325,000 W	1000'	52.0	10,000 W	1000'	81.0 mi	133.0

* Distances taken from BP-5

TABLE 6
SEPARATION BETWEEN TWO UHF CO-CHANNELS.
 (Based on a protection ratio of 30 dB at the "B" contour.)

<u>Existing Station</u> ERP (watts)	EHAAT	Distance (mi) to contour "B" (64 dBu)	<u>Planned Station</u> ERP (watts)	EHAAT	Distance (mi) to 34 dBu	Total Separation required (mi)
1 W	100'	0.9	1 W	100'	5.0	5.9
10 W	100'	1.8	10 W	100'	9.0	10.8
100 W	100'	3.0	100 W	100'	15.5	18.3
100 W	300'	4.9	100 W	300'	24.0	28.9
100,000 W	1000'	33.5	100 W	300'	24.0	57.5
100,000 W	1000'	33.5	1,000 W	1000'	43.0	76.5
100,000 W	1000'	33.5	10,000 W	1000'	56.0	89.5

Note: All separations based on propagation over an average terrain.

TABLE 7
 AM COVERAGE - DISTANCES TO VARIOUS CONTOURS - 100 W
 (Based on the use of a small L or T radiating antenna)

Frequency: 1180 - 1240 KHZ

Distance (mi) to	Ground Conductivities (e.m.u x 10 ¹⁴)							
	1	2	4	6	10	20	40	5000
4.0 m V/m contour	0.9	1.0	1.4	1.6	1.7	1.8	1.9	2.0
1.0 m V/m contour	2.1	2.8	3.9	4.6	5.5	6.5	7.2	8.0
0.1 m V/m contour	7.0	9.0	13.0	17.0	22.0	31.0	41.0	70.0

Frequency: 1430 - 1510 KHZ

Distance (mi) to	Ground Conductivities (e.m.u x 10 ¹⁴)							
	1	2	4	6	10	20	40	5000
4.0 m V/m	0.55	0.7	0.9	1.0	1.1	1.2	1.25	1.30
1.0 m V/m	1.6	2.4	3.2	4.0	5.0	6.0	7.0	8.0
0.1 m V/m	6.0	7.4	11.0	13.5	18.0	26.0	38.0	70.0

AM COVERAGE - DISTANCES TO VARIOUS CONTOURS - 50 W
 (Based on the use of a small L or T radiating antenna)

Frequency: 1180 - 1240 KHZ

Distance (mi) to	Ground Conductivities (e.m.u x 10 ¹⁴)							
	1	2	4	6	10	20	40	5000
4.0 m V/m	0.65	0.85	1.1	1.2	1.3	1.35	1.40	1.45
1.0 m V/m	1.7	2.3	3.1	3.8	4.3	5.0	5.3	5.8
0.1 m V/m	5.9	7.8	11.5	14.0	18.0	26.0	34.0	50.0

Frequency: 1430 - 1510 KHZ

Distance (mi) to	Ground Conductivities (e.m.u x 10 ¹⁴)							
	1	2	4	6	10	20	40	5000
4.0 m V/m	0.60	0.80	1.0	1.1	1.3	1.35	1.40	1.45
1.0 m V/m	1.60	2.10	2.8	3.2	4.0	4.8	5.0	5.8
0.1 m V/m	5.1	7.0	10.0	12.5	17.0	25.0	32.0	50.0

TABLE 7 (cont'd)
 AM COVERAGE - DISTANCES TO VARIOUS CONTOURS - 250 W
 (Based on the use of a small L or T radiating antenna)

Frequency: 1180 - 1240 KHZ

Distance (mi) to	Ground Conductivities (e.m.u x 10 ¹⁴)							
	1	2	4	6	10	20	40	5000
4.0 m V/m contour	1.1	1.5	2.1	2.4	2.7	2.8	3.0	3.2
1.0 m V/m contour	2.6	3.6	5.2	6.3	7.5	9.2	11.0	13.0
0.1 m V/m contour	8.6	11.0	16.0	20.0	27.0	40.0	55.0	100.0

Frequency: 1430 - 1500 KHZ

Distance (mi) to	Ground Conductivities (e.m.u x 10 ¹⁴)							
	1	2	4	6	10	20	40	5000
4.0 m V/m contour	1.1	1.4	1.8	2.2	2.6	2.8	2.9	3.1
1.0 m V/m contour	2.5	3.2	4.4	5.6	7.0	9.0	10.5	13.0
0.1 m V/m contour	7.8	10.0	14.0	17.5	25.0	34.0	50.0	100.0

TABLE 8
 TERRAIN ROUGHNESS FACTOR

Type of terrain	Equivalent h in meters
Water or very smooth terrain	0- 1
Smooth terrain	10- 20
Slightly rolling terrain	40- 60
Hilly terrain	80-150
Rugged mountains	200-500

Note: The terrain roughness factors above were used to estimate the correction required on the FCC 50/50 curves for TV and FM broadcasting, to yield various coverage contours for different terrain. The correction, in dB is indicated in the tables, and was obtained from curves taken from FCC report on the development of VHF and UHF propagation curves for TV and FM broadcasting.

TABLE 9
DISTANCES TO GRADE "B" in TV and 500 μ V/M IN FM FOR VARIOUS TERRAINS

Effective Radiated Power	Antenna Height Above Average Terrain (feet)	Terrain Type #1 flat $\Delta h = 10$ m				Average Terrain Slightly Rolling $\Delta h = 50$ m				Terrain Type #2 Hilly $\Delta h = 100$ m				Terrain Type #3 Entrrenched Topography $\Delta h = 400$ m			
		TV Dist. to Grade "B" FM: to 500 μ V/m (miles)				TV Dist. to Grade "B" FM: to 500 μ V/m (miles)				TV Dist. to Grade "B" FM: to 500 μ V/m (miles)				TV Dist. to Grade "B" FM: to 500 μ V/m (miles)			
Broadcast Service		L-VHF	FM	H-VHF	UHF	L-VHF	FM	H-VHF	UHF	L-VHF	FM	H-VHF	UHF	L-VHF	FM	H-VHF	UHF
Correction factor for the received field strength (dB)		+2.0	+2.0	+2.5	+4.0	-	-	-	-	-2.0	-2.0	-2.5	-5.0	-13.0	-13.0	-17.5	-33.0
1 W	100'	2.8	1.9	1.9	1.2	2.5	1.7	1.7	0.9	2.1	1.5	1.4	0.5	1.0	0.5	0.5	-
10 W	100'	5.0	3.2	3.2	2.0	4.3	2.9	2.9	1.7	3.9	2.7	2.5	1.2	2.0	1.5	1.0	-
100 W	100'	9.0	6.0	6.0	3.7	8.0	5.0	5.0	2.9	7.0	4.6	4.3	2.1	3.7	2.6	1.9	-
100 W	300'	14.5	10.0	10.5	6.0	13.5	8.5	8.5	4.8	11.5	6.5	7.5	3.7	6.5	4.2	3.2	0.5
100 W	1,000'	27.0	19.0	21.0	11.0	24.0	17.0	19.0	8.5	22.0	15.0	16.5	6.0	12.0	7.5	6.0	0.5
1,000 W	100'	15.0	10.0	10.0	6.0	13.5	9.0	9.0	5.0	12.0	8.0	8.0	3.8	6.5	4.5	3.2	0.7
1,000 W	300'	24.0	18.0	18.0	10.5	21.0	16.0	16.5	8.5	19.5	14.0	14.0	7.0	11.0	7.0	5.5	1.5
1,000 W	1,000'	42.0	30.0	35.0	19.0	38.0	28.0	32.0	15.0	34.5	25.0	29.0	11.0	20.0	15.0	11.5	1.7
10,000 W	300'	39.0	28.0	29.0	19.5	35.0	26.0	27.0	15.5	31.0	23.5	25.0	11.0	19.0	14.0	9.0	2.5
10,000 W	1,000'	57.0	45.0	48.0	28.0	54.0	42.0	46.0	25.0	50.0	40.0	44.0	25.0	34.0	25.0	21.0	3.7

TABLE 10
DISTANCE TO A "PASSABLE" TV PICTURE FOR VARIOUS TERRAINS

Effective Radiated Power	Antenna Height Above Average Terrain	Terrain Type #1 flat $\Delta h = 10 \text{ m}$			Average Terrain Slightly Rolling $\Delta h = 50 \text{ m}$			Terrain Type #2 Hilly $\Delta h = 100 \text{ m}$			Terrain Type #3 Entrenched Topography $\Delta h = 400 \text{ m}$		
		Distances to a "passable" T.V. picture			Distances to a "passable" T.V. picture			Distances to a "passable" T.V. picture			Distances to a "passable" T.V. picture		
Broadcast Service		L-VHF	H-VHF	UHF	L-VHF	H-VHF	UHF	L-VHF	H-VHF	UHF	L-VHF	H-VHF	UHF
Correction factor for the received field strength (dB)		+2.0	+2.5	+4.0	-	-	-	-2.0	-2.5	-5.0	-13.0	-17.5	-33.0
1 W	100'	3.7	2.3	1.6	3.1	2.0	1.2	2.8	1.8	0.8	1.5	0.8	-
10 W	100'	6.5	4.0	2.6	6.0	3.6	2.0	5.1	3.1	1.7	2.7	1.4	-
100 W	100'	11.5	7.1	4.3	10.0	6.5	3.6	9.0	5.8	2.7	5.9	2.4	0.3
100 W	300'	19.0	12.5	8.0	18.0	11.0	6.5	15.5	10.0	4.6	8.0	4.0	0.8
100 W	1,000'	34.0	28.0	15.0	31.0	24.0	11.0	28.0	20.0	9.4	15.0	7.0	2.2
1,000 W	100'	20.0	13.0	8.0	18.5	11.5	6.0	17.0	9.0	4.8	8.5	4.0	1.0
1,000 W	300'	30.0	22.0	15.0	27.0	20.0	10.5	25.0	18.0	8.0	14.0	7.5	1.7
1,000 W	1,000'	50.0	42.0	23.0	47.0	38.0	19.5	43.0	35.0	15.0	26.0	14.0	2.3
10,000 W	300'	46.0	35.0	22.0	42.0	32.0	19.0	40.0	30.0	15.5	24.0	13.0	2.8
10,000 W	1,000'	66.0	52.0	32.0	62.0	50.0	29.0	58.0	48.0	24.0	42.0	28.0	5.0

Note: Based on field strengths of 42 d bu for low VHF, 52 d bu for high VHF, 60 d bu for UHF, at the receiving installations

TABLE 11
DISTANCES TO A "PASSABLE" TV PICTURE FOR VARIOUS TERRAINS
UHF BAND

Effective Radiated Power	Antenna Height Above Average Terrain	Terrain Type #1 flat $\Delta h = 10 \text{ m}$			Average Terrain Slightly Rolling $\Delta h = 50 \text{ m}$			Terrain Type #2 Hilly $\Delta H = 100 \text{ m}$			Terrain Type #3 Entrenched Topography $\Delta h = 400 \text{ m}$		
		Distances to a "passable" T.V. picture			Distances to a "passable" T.V. picture			Distances to a "passable" T.V. picture			Distances to a "passable" T.V. picture		
Broadcast Service		L	M	H	L	M	H	L	M	H	L	M	H
Correction factor for the received field strength (dB)		+4.0	+4.0	+3.0	+1.0	0.0	-1.0	-3.0	-5.0	-7.0	-26.0	-33.0	-43.0
1 W	100'	1.8	1.4	0.9	1.5	1.0	0.5	1.1	0.5	-	-	-	-
10 W	100'	2.9	2.2	1.7	2.5	1.9	1.4	1.9	1.4	1.0	0.2	-	-
100 W	100'	5.0	4.0	3.0	4.0	2.7	2.2	3.4	2.2	1.8	0.9	-	-
100 W	300'	8.0	7.0	5.0	7.0	5.5	4.0	6.0	4.0	2.9	1.5	0.5	-
100 W	1,000'	16.0	12.0	9.0	14.0	9.5	7.5	10.0	7.5	4.8	2.0	0.8	-
1,000 W	100'	9.0	7.0	5.0	8.0	6.0	4.0	7.0	4.0	2.9	1.6	0.8	-
1,000 W	300'	16.0	12.0	9.0	14.0	9.5	8.0	10.0	8.0	5.0	2.7	1.4	-
1,000 W	1,000'	25.0	21.0	17.0	22.0	17.0	14.0	18.5	14.0	9.0	4.5	1.9	0.4
10,000 W	300'	24.0	20.0	16.0	21.0	17.0	13.0	18.0	13.0	9.0	4.8	2.6	1.0
10,000 W	1,000'	34.0	30.0	26.0	31.0	27.0	21.0	27.0	21.0	17.0	8.5	4.2	1.3

Note: Based on

L = Low UHF band; signal strength = 58 dBu

M = Middle UHF band; signal strength = 62 dBu

H = High UHF band; signal strength = 66 dBu

at the receiving installations.

TABLE 12
DISTANCES TO A "PASSABLE" TV PICTURE FOR VARIOUS TERRAINS AND ASSUMING A 6 dB
BETTER THAN AVERAGE RECEIVING INSTALLATION

Effective Radiated Power	Antenna Height Above Average Terrain	Terrain Type #1 flat $\Delta h = 10 \text{ m}$			Average Terrain Slightly Rolling $\Delta h = 50 \text{ m}$			Terrain Type #2 Hilly $\Delta h = 100 \text{ m}$			Terrain Type #3 Entrrenched Topography $\Delta h = 400 \text{ m}$		
		Distances to a "passable" T.V. picture +6.0 dB			Distances to a "passable" T.V. picture +6.0 dB			Distances to a "passable" T.V. picture +6.0 dB			Distances to a "passable" T.V. picture +6.0 dB		
Broadcast Service		L-VHF	H-VHF	UHF	L-VHF	H-VHF	UHF	L-VHF	H-VHF	UHF	L-VHF	H-VHF	UHF
Correction factor for the received field strength (dB)		+8.0	+8.5	+10.0	+6.0	+6.0	+6.0	+4.0	+3.5	+1.0	-7.0	-11.5	-27.0
1 W	100'	5.0	3.0	2.0	4.5	2.8	1.7	4.0	2.6	1.2	2.2	1.1	-
10 W	100'	9.5	5.5	3.7	8.5	5.0	2.9	7.0	4.5	2.1	4.0	1.9	-
100 W	100'	16.0	10.0	6.0	14.0	8.5	5.0	13.0	7.5	3.8	7.0	3.5	0.7
100 W	300'	27.0	18.0	11.0	24.0	17.0	8.0	21.0	15.0	6.5	12.0	6.5	1.2
100 W	1,000'	44.0	35.0	19.0	40.0	32.0	16.0	38.0	28.0	12.0	22.0	11.0	1.7
1,000 W	100'	27.0	18.0	11.0	24.0	16.0	9.0	22.0	15.0	7.0	12.0	6.0	1.2
1,000 W	300'	40.0	30.0	19.0	38.0	28.0	16.0	34.0	25.0	12.0	20.0	10.0	2.2
1,000 W	1,000'	60.0	48.0	29.0	56.0	46.0	25.0	52.0	43.0	20.0	37.0	20.0	3.8
10,000 W	300'	55.0	42.0	28.0	51.0	40.0	25.0	49.0	38.0	20.0	32.0	19.0	4.0
10,000 W	1,000'	76.0	60.0	38.0	72.0	58.0	34.0	69.0	54.0	29.0	51.0	36.0	7.0

Note: Based on field strengths of

42 dBu for low VHF
52 dBu for high VHF
60 dBu for UHF

at receiving installations better than average by 6 dB.

TABLE 13
DISTANCES TO A "PASSABLE" TV PICTURE FOR VARIOUS TERRAINS AND ASSUMING A 6 dB
BETTER THAN AVERAGE RECEIVING INSTALLATION
UHF BAND

Effective Radiated Power	Antenna Height Above Average Terrain	Terrain Type #1 flat $\Delta h = 10 \text{ m}$			Average Terrain Slightly Rolling $\Delta h = 50 \text{ m}$			Terrain Type #2 Hilly $\Delta h = 100 \text{ m}$			Terrain Type #3 Entrenched Topography $\Delta h = 400 \text{ m}$		
		Distances to a "passable" T.V. picture +6.0 dB			Distances to a "passable" T.V. picture +6.0 dB			Distances to a "passable" T.V. picture +6.0 dB			Distances to a "passable" T.V. picture +6.0 dB		
Broadcast Service		L	M	H	L	M	H	L	M	H	L	M	H
Correction factor for the received field strength (dB)		+10.0	+10.0	+9.0	+7.0	+6.0	+5.0	+3.0	+1.0	-1.0	-20.0	-27.0	-37.0
1 W	100'	2.2	1.8	1.5	1.9	1.6	1.1	1.7	1.1	0.5	-	-	-
10 W	100'	3.9	3.1	2.5	3.4	2.6	1.9	2.8	1.9	1.4	0.5	-	-
100 W	100'	7.5	6.0	4.0	6.5	4.5	3.4	4.8	3.4	2.2	1.3	0.6	-
100 W	300'	13.0	9.5	7.0	10.0	8.0	6.0	8.5	6.0	4.0	2.1	1.1	-
100 W	1,000'	21.0	18.0	14.0	18.5	13.5	10.0	14.5	10.0	7.0	3.5	1.3	-
1,000 W	100'	12.0	9.5	8.0	10.0	8.0	7.0	8.5	7.0	4.0	2.2	1.2	0.5
1,000 W	300'	20.0	17.0	14.0	18.0	14.0	10.0	15.5	10.0	8.0	3.9	2.0	0.8
1,000 W	1,000'	30.0	26.0	22.0	27.0	22.0	18.5	23.0	18.5	14.0	7.0	3.2	0.9
10,000 W	300'	29.0	26.0	21.0	27.0	22.0	18.0	23.0	18.0	13.0	7.0	3.5	1.6
10,000 W	1,000'	39.0	35.0	31.0	36.0	31.0	27.0	32.0	27.0	21.0	12.0	6.5	2.2

Note: Based on:

L = Low UHF band; signal strength = 58 dBu

M = Middle UHF band; signal strength = 62 dBu

H = High UHF band; signal strength = 66 dBu

at the receiving installation.

TABLE 14
 TV COVERAGE FOR LESS THAN 1 WATT ERP
 (see also figures 8 and 9)

Following Grade B coverage, assuming an antenna height of 100' and average terrain:

TX Antenna Gain	ERP	Low VHF	High VHF	UHF
0 dB	.084 watt	1.4 mi	0.9 mi	0.5 mi
10 dB	.84 watt	2.4 mi	1.8 mi	1.0 mi

Based on TV modulator/amplifier with output of +60 dBmV and 2 dB line loss

TX Antenna Gain	ERP	Low VHF	High VHF	UHF
0 dB	.05 watt	1.3 mi	0.7 mi	0.4 mi
10 dB	.5 watt	2.2 mi	1.6 mi	0.8 mi

Based on CATV amplifier output of + 56 dBmV and 2 dB line loss

TABLE 15
COST DETAILS: 1-WATT POLE MOUNTED MODEL

A. CIVIL, ELECTRICAL AND MECHANICAL CAPITAL COST ESTIMATES	1 TV Channel	2 TV Channels	3 TV Channels 2 Transmitters + 1 Translator	4 TV Channels 2 Transmitters + 2 Translators	4 TV Channels & 2 FM Channels
Site Clearance	500	500	500	500	500
80 foot wood pole with guys + foundations	3,300	3,300	3,300	3,300	3,300
Support for Equipment housing	300	300	600	600	600
Electrical work on Tower including Grounding	1,500	1,500	1,500	1,500	1,500
Electrical Connection to Equipment	300	300	300	300	300
Total Civil/Electrical/Mechanical	5,900	5,900	6,200	6,200	6,200

TABLE 15 (cont'd)
COST DETAILS: 1-WATT POLE MOUNTED MODEL

B. ELECTRONIC CAPITAL COST ESTIMATES	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels + 2 FM
<u>1. TV Translator on two channels</u> Receiving antenna Cable run Environmental Enclosure Translator Translator Combiner Cable Run Transmitting antenna			310 150 2,850 3,100 350 360	310 150 2,850 3,100 3,100 350 350 360	310 150 2,850 3,100 3,100 350 350 360
<u>2. TV Transmitter on two channels</u> Environmental Enclosure 1 Watt TV Transmitter 1 Watt TV Transmitter Cable Run Cable Run Transmitting antenna Transmitting antenna	2,800 5,300 5,300 350 350 360 360	2,850 5,300 5,300 350 350 360 360	2,850 5,300 5,300 350 350 360 360	2,850 5,300 5,300 350 350 360 360	2,850 5,300 5,300 350 350 360 360
<u>3. FM Section</u> Environmental enclosure Receiving Antenna Cable Run (Receive) FM Translator FM Transmitter Combiner Cable Run (Transmit) Transmitting Antenna					2,850 310 150 2,700 3,400 350 350 310
<u>TOTAL B1 + B2 + B3</u>	8,860	14,870	21,990	25,440	35,860

TABLE 15 (cont'd)
 COST DETAILS: 1-WATT POLE MOUNTED MODEL

C. OTHER CAPITAL COSTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels + 2 FM
<u>1. Civil/Electrical/Mechanical</u>					
Engineering	3,000	3,000	3,000	3,000	3,000
Site Supervision	1,000	1,000	1,000	1,000	1,000
<u>2. Electronics</u>					
Engineering	6,000	6,400	6,800	7,200	8,000
Supervision	1,000	1,000	1,000	1,000	1,000
Installation	3,000	3,200	3,400	3,600	4,000
<u>TOTAL C1 + C2</u>	14,000	14,600	15,200	15,800	17,000
<u>TOTAL A + B + C</u>	28,760	35,370	43,690	47,440	59,060
Rounded off Total	29,000	35,000	44,000	47,000	59,000

TABLE 16
COST OF ENGINEERING AND SITE SUPERVISION

DESCRIPTION OF SERVICES	Pole mounted & specialized shelter models	Standard Shelter model		Existing housing model
	4 channels + 2 FM	4 channels + 2 FM	8 channels + 2 FM	8 channels + 2 FM
A. Civil, electrical, mechanical works				
Engineering	3,000	9,000	9,000	4,000
Site Supervision	1,000	1,000	1,000	1,000
S/TOTAL A	4,000	10,000	10,000	5,000
B. Electronic Equipment				
Engineering	8,000	10,000	15,000	10,000
Supervision	1,000	2,000	3,000	2,000
Installation	4,000	8,000	10,000	6,000
S/TOTAL B	13,000	20,000	28,000	18,000
TOTAL A + B	17,000	30,000	38,000	23,000

TABLE 17
 COSTS OF CIVIL, ELECTRICAL AND
 MECHANICAL WORKS - STANDARD SHELTER MODEL

Site Clearance	\$ 500
Building	7,200
Tower (including installation of antennas)	9,900
Power line drop connection	2,000
Tower electrical and grounding	2,500
Other electrical works	300
Safety fence around tower base	600
	<hr/>
TOTAL	\$23,000

To obtain costs for specific cases, the cost of the corresponding element is changed. For example, if a building of size 12' x 12' is required instead of an 8' x 12', the \$7,200 figure is replaced by 10,800 resulting in an increase of 3,600 in the basic site cost. \$500 allowance is made for installing additional antennas. Figures 20 to 23 present the variations of tower costs in relation with height and ice loading for several wind pressured.

TABLE 18

COST SUMMARY: 1-WATT POLE MOUNTED MODEL - 2-MILE COVERAGE - HIGH-BAND VHF

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels & 2 FM Channels
<u>Capital Costs</u>					
- Civil Electrical and Mechanical works	5,900	5,900	6,200	6,200	6,200
- Engineering & Site Supervision	4,000	4,000	4,000	4,000	4,000
- Electronic Equipment	9,110	15,370	22,740	26,440	37,360
- Engineering, Site Supervision plus Installation of Electronics	<u>10,000</u>	<u>10,600</u>	<u>11,200</u>	<u>11,800</u>	<u>13,000</u>
- Total Capital Cost (rounded off to the closest 000)	29,000	36,000	44,000	48,000	61,000
- Equivalent annual cost (amortized over 15 years at 12% per annum compounded semi-annually factor 0.142)	4,118	5,112	6,248	6,816	8,662
- % of Total annual cost (rounded off)	52	57	62	63	68
<u>Recurring costs on a yearly basis</u>					
- Operation	200	200	200	200	200
- Maintenance, civil, electrical, mechanical	2,000	2,000	2,000	2,000	2,000
- Maintenance, electronics	<u>1,600</u>	<u>1,650</u>	<u>1,700</u>	<u>1,750</u>	<u>1,850</u>
- Total annual recurring costs	3,800	3,850	3,900	3,950	4,050
- % of total annual cost	48	43	38	37	32
<u>TOTAL ANNUAL COST</u>	7,918	8,962	10,148	10,766	12,712
Cost per month	660	747	846	897	1,059

TABLE 19

COST SUMMARY: 10-WATT POLE MOUNTED MODEL - 4-MILE COVERAGE - HIGH-BAND VHF

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels & 2 FM Channels
<u>Capital Costs</u>					
- Civil Electrical and Mechanical works	5,900	6,200	6,500	6,800	7,100
- Engineering, & Site Supervision	4,000	4,000	4,000	4,000	4,000
- Electronic Equipment	11,110	22,220	30,690	38,370	50,060
- Engineering, Site Supervision plus Installation of Electronics	<u>10,000</u>	<u>10,600</u>	<u>11,200</u>	<u>11,800</u>	<u>13,000</u>
- Total Capital Cost (rounded off)	31,000	43,000	52,000	61,000	74,000
- Equivalent annual cost	4,402	6,106	7,384	8,662	10,508
- % of Total annual cost (rounded off)	54	61	65	68	72
<u>Recurring costs</u>					
- Operation	200	220	240	260	300
- Maintenance, civil, electrical, mechanical	2,000	2,000	2,000	2,000	2,000
- Maintenance, electronics	<u>1,600</u>	<u>1,650</u>	<u>1,700</u>	<u>1,750</u>	<u>1,850</u>
- Total annual recurring costs	3,800	3,870	3,940	4,010	4,150
- % of total annual cost	46	39	35	32	28
<u>TOTAL ANNUAL COST</u>	8,202	9,976	11,324	12,672	14,658
Cost per month	684	832	944	1,056	1,222

TABLE 20

COST SUMMARY: STANDARD SHELTER MODEL - 8-MILE BASIC COVERAGE - HIGH BAND VHF

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels 2 TX + 1 TXL	4 TV Channels + 2 FM	5 TV Channels	6 TV Channels	7 TV Channels	8 TV Channels	8 TV Channels + 2 FM
<u>Capital Costs</u>									
- Civil Electrical and Mechanical works	23,000	23,000	23,000	27,100	27,100	35,500	35,500	35,500	35,500
- Engineering, & Site Supervision	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
- Electronic Equipment	27,500	55,000	78,310	121,825	127,860	155,360	178,670	200,720	222,180
- Engineering, Site Supervision plus Installation of Electronics	<u>12,000</u>	<u>14,000</u>	<u>16,000</u>	<u>20,000</u>	<u>20,000</u>	<u>22,000</u>	<u>24,000</u>	<u>26,000</u>	<u>28,000</u>
- Total Capital Cost (rounded off)	72,000	102,000	127,000	179,000	185,000	223,000	248,000	272,000	296,000
- Equivalent annual cost (factor is 0.142)	10,224	14,484	18,034	25,418	26,270	31,666	35,216	38,624	42,032
- % of Total annual cost	65	70	72	74	75	76	77	77	77
<u>Recurring costs</u>									
- Operation	500	700	900	1,500	1,300	1,500	1,700	1,900	2,300
- Maintenance, civil, electrical, mechanical	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
- Maintenance, electronics	<u>2,650</u>	<u>3,100</u>	<u>3,550</u>	<u>5,200</u>	<u>5,200*</u>	<u>6,100</u>	<u>6,550</u>	<u>7,000</u>	<u>7,900</u>
- Total annual recurring costs	5,550	6,200	6,850	9,100	8,900	10,000	10,650	11,300	12,600
- % of total annual cost	35	30	28	26	25	24	23	23	23
<u>TOTAL ANNUAL COST</u>	15,774	20,680	24,884	34,518	35,170	41,666	45,866	49,924	54,632
Cost per month	1,315	1,724	2,074	2,877	2,919	3,472	3,822	4,160	4,553

* Figures were adjusted to smooth out the transition

COST SUMMARY: STANDARD SHELTER MODEL - 14-MILE BASIC COVERAGE - HIGH BAND VHF

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels 2 TX + 1 TXL	4 TV Channels + 2 FM	5 TV Channels	6 TV Channels	7 TV Channels	8 TV Channels	8 TV Channels + 2 FM Channels
<u>Capital Costs</u>									
- Civil Electrical and Mechanical works	32,100	32,100	35,700	35,700	35,700	44,600	44,600	44,600	44,600
- Engineering, & Site Supervision	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
- Electronic Equipment	43,350	86,700	123,310	187,420	199,410	242,760	279,370	312,120	343,480
- Engineering, Site Supervision plus Installation of the Electronics	<u>12,000</u>	<u>14,000</u>	<u>16,000</u>	<u>20,000</u>	<u>20,000</u>	<u>22,000</u>	<u>24,000</u>	<u>26,000</u>	<u>28,000</u>
- Total Capital Cost (rounded off)	98,000	143,000	181,000	253,000	265,000	319,000	358,000	393,000	426,000
- Equivalent annual cost (factor is 0.142)	13,916	20,306	25,702	35,926	37,630	45,298	50,836	55,806	60,492
- % of Total annual cost	70	74	76	76	78	79	79	80	79
<u>Recurring costs</u>									
- Operation	900	1,500	2,100	3,900	3,000	3,600	4,200	4,800	6,000
- Maintenance, civil, electrical, mechanical	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
- Maintenance, electronics	<u>2,650</u>	<u>3,100</u>	<u>3,550</u>	<u>5,200</u>	<u>5,200*</u>	<u>6,100</u>	<u>6,550</u>	<u>7,000</u>	<u>7,900</u>
- Total annual recurring costs	5,950	7,000	8,050	11,500	10,600	12,100	13,150	14,200	16,300
- % of total annual cost	30	26	24	24	22	21	21	20	21
<u>TOTAL ANNUAL COST</u>	19,866	27,306	33,752	47,426	48,230	57,398	63,986	70,006	76,792
Cost per month	1,656	2,276	2,813	3,952	4,020	4,784	5,333	5,834	6,400

* Remark: Figures were adjusted to smooth out the transition

TABLE 22

COST SUMMARY: 1-WATT SPECIALIZED SHELTER MODEL - 2-MILE COVERAGE - HIGH BAND VHF

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels & 2 FM Channels
<u>Capital Costs</u>					
- Civil Electrical and Mechanical works	12,300	12,300	12,300	12,300	12,300
- Engineering, & Site Supervision	4,000	4,000	4,000	4,000	4,000
- Electronic Equipment	6,660	12,920	17,840	21,540	29,610
- Engineering, Site Supervision plus Installation of Electronics	<u>10,000</u>	<u>10,600</u>	<u>11,200</u>	<u>11,800</u>	<u>13,000</u>
- Total Capital Cost (rounded off)	33,000	40,000	45,000	50,000	59,000
- Equivalent annual cost	4,686	5,680	6,390	7,100	8,378
- % of Total annual cost (rounded off)	68	72	74	75	77
<u>Recurring costs</u>					
- Operation	300	300	300	300	300
- Maintenance, civil, electrical, mechanical	300	300	300	300	300
- Maintenance, electronics	<u>1,600</u>	<u>1,650</u>	<u>1,700</u>	<u>1,750</u>	<u>1,850</u>
- Total annual recurring costs	2,200	2,250	2,300	2,350	2,450
- % of total annual cost	32	28	26	25	23
<u>TOTAL ANNUAL COST</u>	6,886	7,930	8,690	9,450	10,828
Cost per month	574	661	725	788	902

TABLE 23

COST SUMMARY: 1-WATT EXISTING HOUSING MODEL - 2-MILE COVERAGE - HIGH BAND VHF

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels + 2 FM Channels	5 TV Channels	6 TV Channels	7 TV Channels	8 TV Channels	8 TV Channels + 2 FM Channels
<u>Capital Costs</u>										
- Civil Electrical and Mechanical works	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
- Engineering, & Site Supervision	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
- Electronic Equipment	6,660	12,920	17,840	21,540	29,610	28,200	34,460	39,380	43,080	51,150
- Engineering, Site Supervision plus Installation of Electronics	<u>10,000</u>	<u>10,600</u>	<u>11,200</u>	<u>11,800</u>	<u>14,000</u>	<u>13,000</u>	<u>15,000</u>	<u>16,000</u>	<u>17,000</u>	<u>18,000</u>
- Total Capital Cost	23,000	30,000	36,000	40,000	50,000	48,000	56,000	62,000	67,000	76,000
- Equivalent annual cost (factor is 0.142)	3,266	4,260	5,112	5,680	7,100	6,816	7,952	8,804	9,514	10,792
- % of Total annual cost	61	66	70	72	74	74	75	77	77	79
<u>Recurring costs</u>										
- Operation	200	200	200	200	300	300	300	300	300	300
- Maintenance, civil, electrical, mechanical	300	300	300	300	300	300	300	300	300	300
- Maintenance, electronics	<u>1,600</u>	<u>1,650</u>	<u>1,700</u>	<u>1,750</u>	<u>1,850</u>	<u>1,900</u>	<u>2,000</u>	<u>2,100</u>	<u>2,200</u>	<u>2,300</u>
- Total annual recurring costs	2,100	2,150	2,200	2,250	2,450	2,500	2,600	2,700	2,800	2,900
- % of total annual cost	39	34	30	28	26	26	25	23	23	21
<u>TOTAL ANNUAL COST</u>	5,366	6,410	7,312	7,930	9,550	9,316	10,552	11,504	12,314	13,692
Cost per month	488	535	610	661	796	776	879	959	1,026	1,141

TABLE 24

COST SUMMARY: 1-WATT POLE MOUNTED MODEL - UHF BAND

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels & 2 FM Channels
<u>Capital Costs</u>					
- Civil Electrical and Mechanical works	5,900	5,900	6,200	6,200	6,200
- Engineering, & Site Supervision	4,000	4,000	4,000	4,000	4,000
- Electronic Equipment	17,310	31,770	44,840	54,240	65,160
- Engineering, Site Supervision plus Installation of Electronics	<u>10,000</u>	<u>10,600</u>	<u>11,200</u>	<u>11,800</u>	<u>13,000</u>
- Total Capital Cost (rounded off to the closest 000)	37,000	52,000	66,000	76,000	88,000
- Equivalent annual cost (amortized over 15 years at 12% per annum compounded semi-annually)	5,254	7,384	9,372	10,792	12,496
- % of Total annual cost (rounded off)	58	66	71	73	76
<u>Recurring costs on a yearly basis</u>					
- Operation	200	200	200	200	200
- Maintenance, civil, electrical, mechanical	2,000	2,000	2,000	2,000	2,000
- Maintenance, electronics	<u>1,600</u>	<u>1,650</u>	<u>1,700</u>	<u>1,750</u>	<u>1,850</u>
- Total annual recurring costs	3,800	3,850	3,900	3,950	4,050
- % of total annual cost	42	34	29	27	24
<u>TOTAL ANNUAL COST</u>	9,054	11,234	13,272	14,742	16,546

TABLE 25

COST SUMMARY: STANDARD SHELTER MODEL - 4-MILE COVERAGE - UHF BAND

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels & 2 FM Channels
<u>Capital Costs</u>					
- Civil Electrical and Mechanical works	19,000	19,000	19,000	19,000	19,000
- Engineering, & Site Supervision	10,000	10,000	10,000	10,000	10,000
- Electronic Equipment	24,860	49,320	71,140	91,420	103,110
- Engineering, Site Supervision plus Installation of Electronics	<u>12,000</u>	<u>14,000</u>	<u>16,000</u>	<u>18,000</u>	<u>20,000</u>
- Total Capital Cost (rounded off)	86,000	92,000	116,000	138,000	152,000
- Equivalent annual cost	9,372	13,064	16,472	19,596	21,584
- % of Total annual cost (rounded off)	68	74	77	80	81
<u>Recurring costs</u>					
- Operation	400	550	700	850	900
- Maintenance, civil, electrical, mechanical	2,400	2,400	2,400	2,400	2,400
- Maintenance, electronics	<u>1,600</u>	<u>1,650</u>	<u>1,700</u>	<u>1,750</u>	<u>1,850</u>
- Total annual recurring costs	<u>4,400</u>	<u>4,600</u>	<u>4,800</u>	<u>5,000</u>	<u>5,150</u>
- % of total annual cost	32	26	23	20	19
<u>TOTAL ANNUAL COST</u>	13,772	17,664	21,272	24,596	26,734

TABLE 26

COST SUMMARY: STANDARD SHELTER MODEL - 8-MILE COVERAGE - UHF BAND

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels 2 TX + 1 TXL	4 TV Channels + 2 FM	5 TV Channels	6 TV Channels	7 TV Channels	8 TV Channels	8 TV Channels + 2 FM
<u>Capital Costs</u>									
- Civil Electrical and Mechanical works	23,000	23,000	23,000	27,100	27,100	35,500	35,500	35,500	35,500
- Engineering, & Site Supervision	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
- Electronic Equipment	66,500	133,000	177,310	241,020	286,060	352,560	396,870	439,120	460,580
- Engineering, Site Supervision plus Installation of Electronics	<u>12,000</u>	<u>14,000</u>	<u>16,000</u>	<u>18,000</u>	<u>20,000</u>	<u>22,000</u>	<u>24,000</u>	<u>26,000</u>	<u>28,000</u>
- Total Capital Cost (rounded off)	112,000	181,000	227,000	298,000	343,000	420,000	466,000	511,000	534,000
- Equivalent annual cost (factor is 0.142)	15,904	25,702	32,234	42,319	48,706	59,640	66,172	72,562	75,828
- % of Total annual cost	71	76	77	77	79	80	80	79	79
<u>Recurring costs</u>									
- Operation	700	1,100	1,500	2,900	2,300	2,700	3,100	3,500	3,900
- Maintenance, civil, electrical, mechanical	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,400
- Maintenance, electronics	<u>3,350</u>	<u>4,500</u>	<u>5,650</u>	<u>7,700</u>	<u>8,400</u>	<u>9,900</u>	<u>11,400</u>	<u>12,900</u>	<u>13,800</u>
- Total annual recurring costs	6,450	8,000	9,550	12,400	13,100	15,000	16,900	18,800	20,100
- % of total annual cost	29	24	23	23	21	20	20	21	21
<u>TOTAL ANNUAL COST</u>	22,354	33,702	41,784	54,719	61,806	74,640	83,072	91,362	95,928

TABLE 27

COST SUMMARY: STANDARD SHELTER MODEL - 14-MILE COVERAGE - UHF BAND

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels 2 TX + 1 TXL	4 TV Channels + 2 FM	5 TV Channels	6 TV Channels	7 TV Channels	8 TV Channels	8 TV Channels + 2 FM
<u>Capital Costs</u>									
- Civil Electrical and Mechanical works	32,100	35,700	44,600	51,800	51,800	51,800	55,400	55,400	55,400
- Engineering, & Site Supervision	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
- Electronic Equipment	76,900	152,300	216,210	307,620	353,160	428,560	492,470	552,520	583,880
- Engineering, Site Supervision plus Installation of the Electronics	12,000	14,000	16,000	20,000	20,000	22,000	24,000	26,000	28,000
- Total Capital Cost (rounded off)	131,000	212,000	287,000	389,000	435,000	512,000	582,000	644,000	677,000
- Equivalent annual cost (factor is 0.142)	18,602	30,104	40,754	55,238	61,770	72,704	82,644	91,448	96,134
- % of Total annual cost	74	78	79	80	80	80	81	81	80
<u>Recurring costs</u>									
- Operation	900	1,600	2,600	4,400	4,100	4,700	5,400	6,000	7,200
- Maintenance, civil, electrical, mechanical	2,400	2,400	2,400	2,400	3,000	3,000	3,000	3,000	3,000
- Maintenance, electronics	3,350	4,500	5,650	7,700	8,400	9,900	11,400	12,900	13,800
- Total annual recurring costs	6,550	8,500	10,650	14,500	15,500	17,600	19,800	21,900	24,000
- % of total annual cost	26	22	21	21	20	20	19	19	20
<u>TOTAL ANNUAL COST</u>	25,152	38,604	51,404	69,738	77,270	90,304	102,444	113,348	120,134

TABLE 28

COST SUMMARY: 1-WATT SPECIALIZED SHELTER MODEL - UHF BAND

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels & 2 FM Channels
<u>Capital Costs</u>					
- Civil Electrical and Mechanical works	12,300	12,300	12,300	12,300	12,300
- Engineering, & Site Supervision	4,000	4,000	4,000	4,000	4,000
- Electronic Equipment	14,860	29,320	39,940	49,340	57,410
- Engineering, Site Supervision plus Installation of Electronics	<u>10,000</u>	<u>10,600</u>	<u>11,200</u>	<u>11,800</u>	<u>13,000</u>
- Total Capital Cost (rounded off)	41,000	56,000	68,000	78,000	87,000
- Equivalent annual cost (factor .142)	5,822	7,952	9,656	11,076	12,354
- % of Total annual cost	73	78	81	82	83
<u>Recurring costs</u>					
- Operation	300	300	300	300	300
- Maintenance, civil, electrical, mechanical	300	300	300	300	300
- Maintenance, electronics	<u>1,600</u>	<u>1,650</u>	<u>1,700</u>	<u>1,750</u>	<u>1,850</u>
- Total annual recurring costs	2,200	2,250	2,300	2,350	2,450
- % of total annual cost	27	22	19	18	17
<u>TOTAL ANNUAL COST</u>	8,022	10,202	11,956	13,426	14,804

TABLE 29

COST SUMMARY: 1-WATT EXISTING HOUSING MODEL - UHF BAND

COST ELEMENTS	1 TV Channel	2 TV Channels	3 TV Channels	4 TV Channels	4 TV Channels + 2 FM Channels	5 TV Channels	6 TV Channels	7 TV Channels	8 TV Channels	8 TV Channels + 2 FM Channels
<u>Capital Costs</u>										
- Civil Electrical and Mechanical works	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800	2,800
- Engineering, & Site Supervision	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
- Electronic Equipment	14,860	29,320	39,940	49,340	57,410	64,200	78,660	89,280	98,680	106,750
- Engineering, Site Supervision plus Installation of the Electronics	<u>10,000</u>	<u>10,600</u>	<u>11,200</u>	<u>11,800</u>	<u>14,000</u>	<u>13,000</u>	<u>15,000</u>	<u>16,000</u>	<u>17,000</u>	<u>18,000</u>
- Total Capital Cost	32,000	47,000	58,000	68,000	78,000	84,000	100,000	112,000	123,000	132,000
- Equivalent annual cost (factor is 0.142)	4,544	6,674	8,236	9,656	11,076	11,928	14,200	15,904	17,466	18,744
- % of Total annual cost	68	76	79	81	82	83	85	86	86	87
<u>Recurring costs</u>										
- Operation	200	200	200	200	300	300	300	300	300	300
- Maintenance, civil, electrical, mechanical	300	300	300	300	300	300	300	300	300	300
- Maintenance,electronics	<u>1,600</u>	<u>1,650</u>	<u>1,700</u>	<u>1,750</u>	<u>1,850</u>	<u>1,900</u>	<u>2,000</u>	<u>2,100</u>	<u>2,200</u>	<u>2,300</u>
- Total annual recurring costs	2,100	2,150	2,200	2,250	2,450	2,500	2,600	2,700	2,800	2,900
- % of total annual cost	32	24	21	19	18	17	15	14	14	13
<u>TOTAL ANNUAL COST</u>	6,644	8,824	10,436	11,906	13,526	14,428	16,800	18,604	20,266	21,644

TABLE 30
POLE MOUNTED MODEL COSTS - MAKE SHIFT ARRANGEMENT (CATV TYPE EQUIPMENT)

COST ELEMENTS	1 CH	2 CH	3 CH	4 CH	5 CH	6 CH	7 CH	8 CH	8 CH + 2 FM
- Civil Electrical and Mechanical Works	5,900	5,900	5,900	5,900	6,400	6,400	6,400	6,400	6,400
- Engineering procurement, site supervision	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
- Electronic Equipment	6,000	7,700	8,800	9,900	15,900	17,600	18,700	19,800	30,000
- Engineering, procurement, site supervision plus installations of Electronics	10,000	10,300	10,600	10,900	11,200	11,500	11,800	12,000	13,000
- Total Capital Cost (rounded off)	26,000	28,000	29,000	31,000	38,000	40,000	41,000	42,000	54,000
- Equivalent annual cost	3,692	3,976	4,118	4,402	5,396	5,680	5,822	5,964	7,668
- A % of total annual cost	49	51	51	53	57	58	59	59	65
Recurring costs									
- Operation	200	200	200	200	200	200	200	200	200
- Maintenance, civil, electric mechanical	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
- Maintenance, electronics	1,600	1,650	1,700	1,750	1,800	1,850	1,900	1,950	2,000
- Total Annual recurring costs	3,800	3,850	3,900	3,950	4,000	4,050	4,100	4,150	4,200
- % of total annual cost	51	49	49	47	43	42	41	41	35
Total Annual Cost	7,492	7,826	8,018	8,352	9,396	9,730	9,922	10,114	11,868

TABLE 31
COST ESTIMATES OF AM INSTALLATIONS

50 watt station

1.	Long wire antenna arrangement	\$ 2,700
2.	Ground system	2,000
3.	Electronics	7,000
4.	Engineering	7,000
5.	Installation and supervision	<u>3,000</u>
	Total Capital Cost (rounded off)	<u>\$22,000</u>
	Equivalent annual cost	3,124
	Yearly operation and maintenance	2,000
	Total estimated annual cost (rounded off)	\$ 5,100

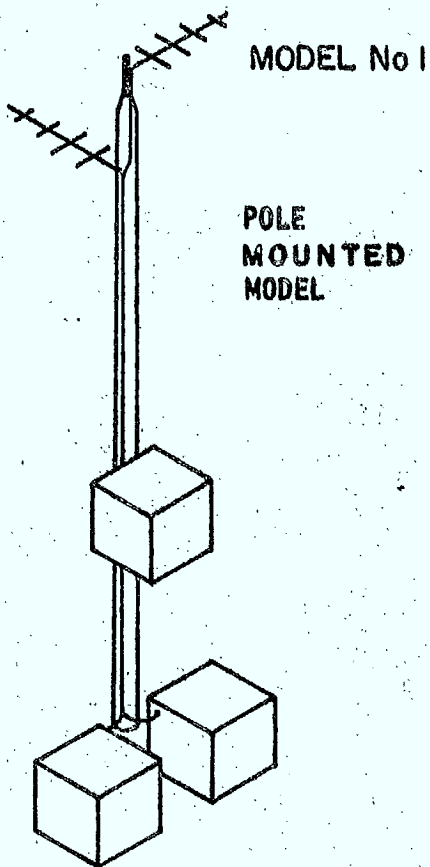
250 watt station

1.	Long wire antenna arrangement	\$ 2,700
2.	Ground system	2,000
3.	Electronics	15,000
4.	Engineering	9,000
5.	Installation and supervision	4,000
6.	Equipment housing	<u>6,000</u>
	Total Capital cost (rounded off)	<u>\$39,000</u>
	Equivalent annual cost	5,538
	Yearly operation and maintenance	2,700
	Total estimated Annual cost (rounded off)	\$ 8,300

DC:

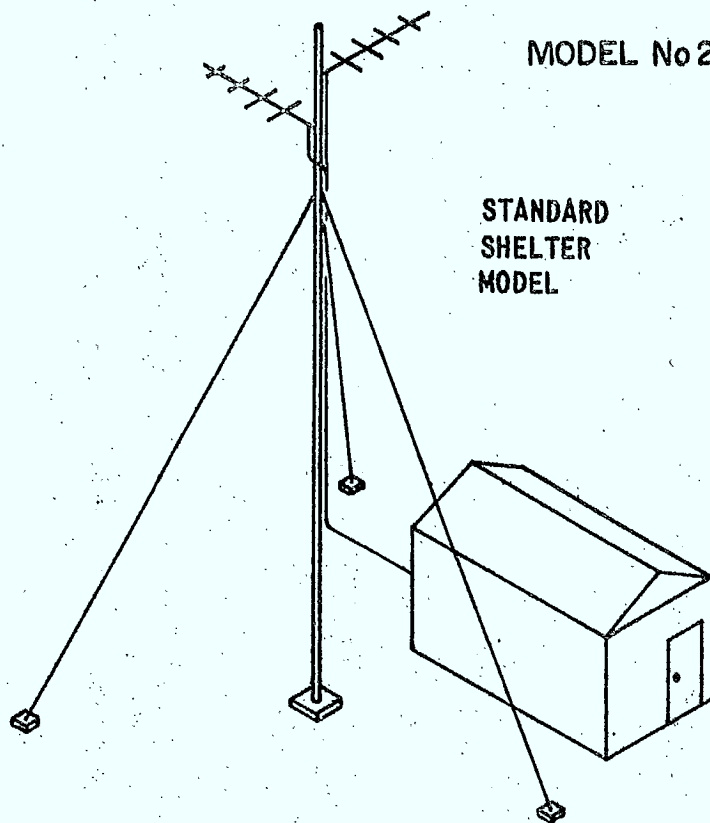
FIGURES 1 TO 23





MODEL No 1

POLE MOUNTED MODEL

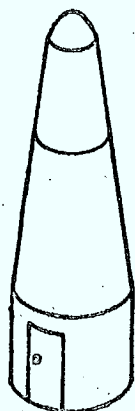


MODEL No 2

STANDARD SHELTER MODEL

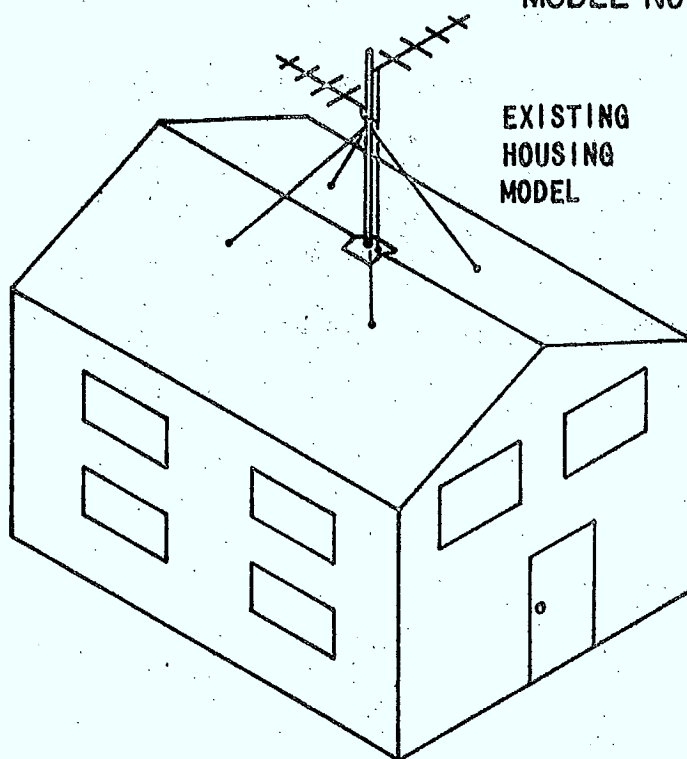
MODEL No 3

SPECIALIZED SHELTER MODEL



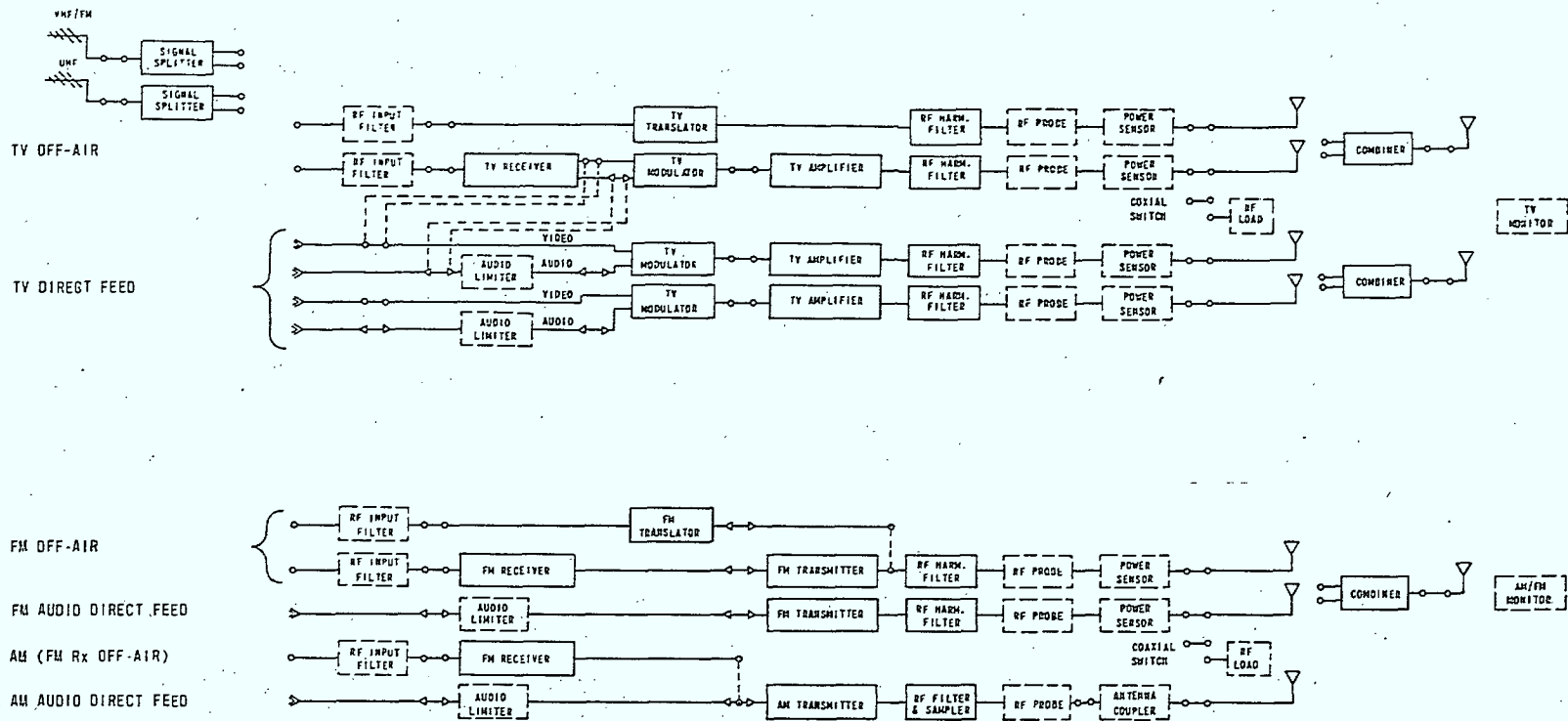
MODEL No 4

EXISTING HOUSING MODEL



4000-11/0 FORMAT "A"

CLIENT		DEPARTMENT OF COMMUNICATIONS		FAIT/MADE	VERIFIE/CHKD	DATE	
PRDJ.		MULTICHANNEL TV REBROADCAST STATIONS		R. FRENETTE	G. JOLIVET	1-02-79	
FIG. 1		ILLUSTRATION OF MODELS		APPR.	ECH./SCALE	DATE REV.	
DYG				F. DI GIANDOMENICO		6-07-79	
CONTR.	SUBDIV.	ELEMENT		NO.	REV.		
5265	0157	47 DD		01	01		



LEGEND
 ○—○ RF JACK
 △—△ AUDIO JACK
 - - - - - OPTIONAL

CLIENT	DEPARTMENT OF COMMUNICATIONS	PAIT MADE	R. FRENETTE	VERIFIED/CHKD	G. JOLIVET	DATE	1-02-79
PROJ	MULTICHANNEL TV REBROADCAST STATIONS	APPR	F. DI GIANDOMENICO	EGH SCALE		DATE REV	6-07-79
D.C.:	FIG.2	4-CHANNEL		ELEMENT	47 DD	NO	REV
		EQUIPMENT BLOCK DIAGRAM					

TV OFF-AIR

TV OFF-AIR

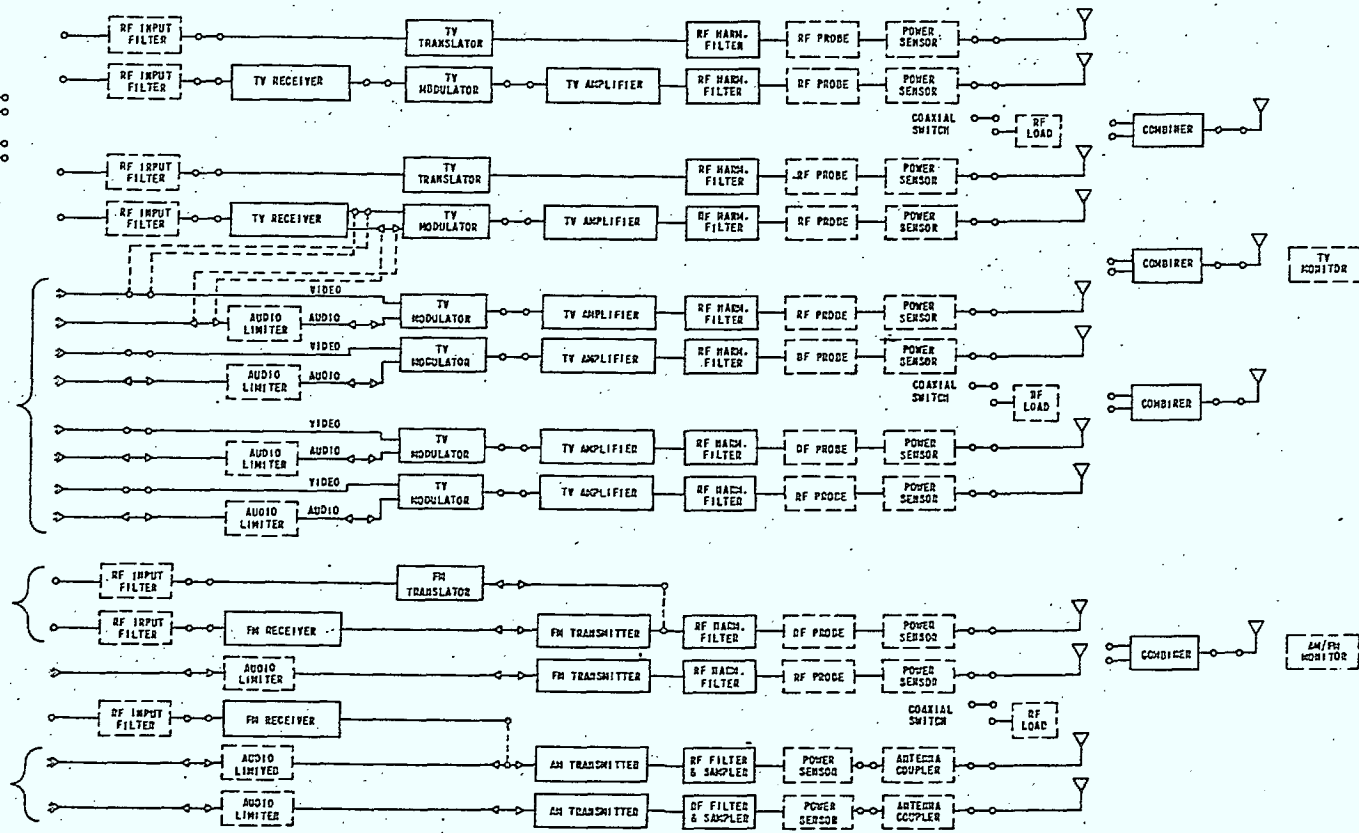
TV DIRECT FEED

FM OFF-AIR

FM AUDIO DIRECT FEED

AU (FM Rx OFF-AIR)

AU AUDIO DIRECT FEED



LEGEND

- RF JACK
- ◇— AUDIO JACK
- OPTIONAL

CLIENT	DEPARTMENT OF COMMUNICATIONS	DESIGNED BY	D. FRENETTE	VERIFIED BY	E. JOLIVET	DATE	1-02-70	
PROJ.	MULTICHANNEL TV BROADCAST STATIONS	APPROVED BY	F. DI GIARDINO	SCALE		DATE	0-07-70	
DWG. NO.	FIG. 3	TITLE	8-CHANNEL EQUIPMENT BLOCK DIAGRAM		NO.	03	REV.	01
COST	5255	SUBNO.	0157	ELEMENT	47 DD			

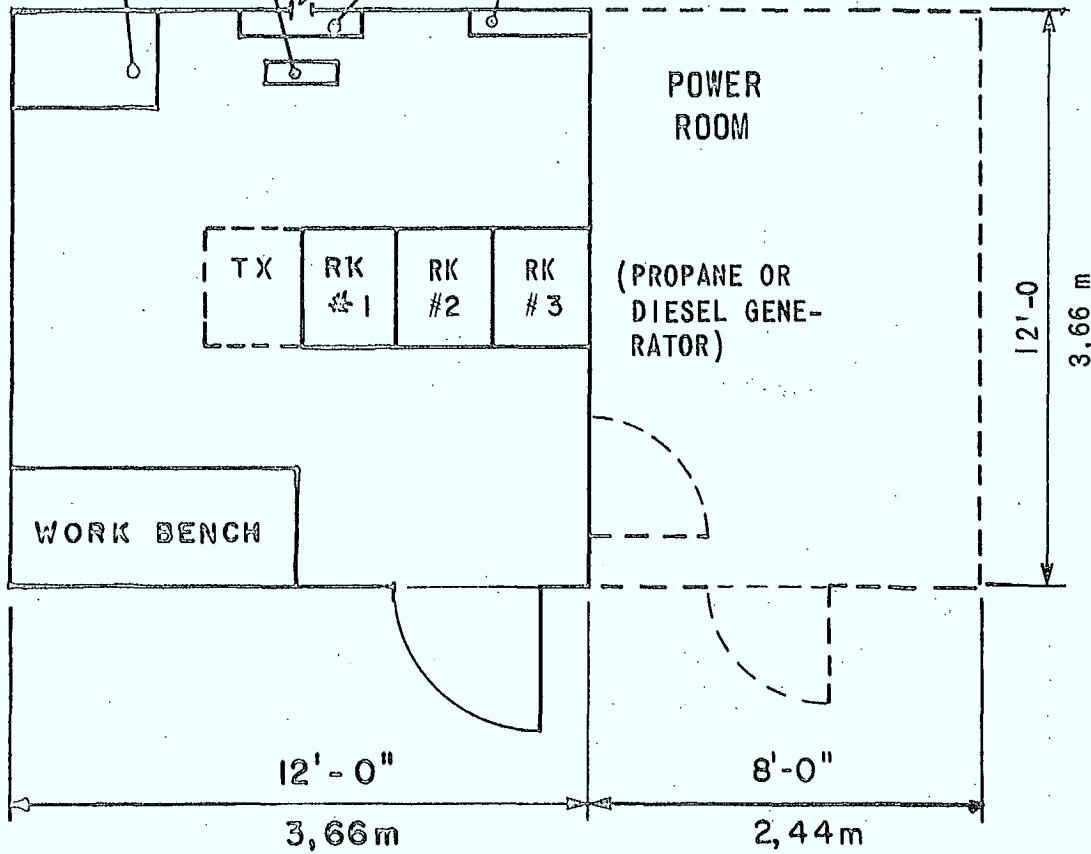
RF LOAD
ANTENNA
& Tx LINE
ACCESSORIES


FILE
CABINET
SPARE PARTS

Tx LINE OPENING

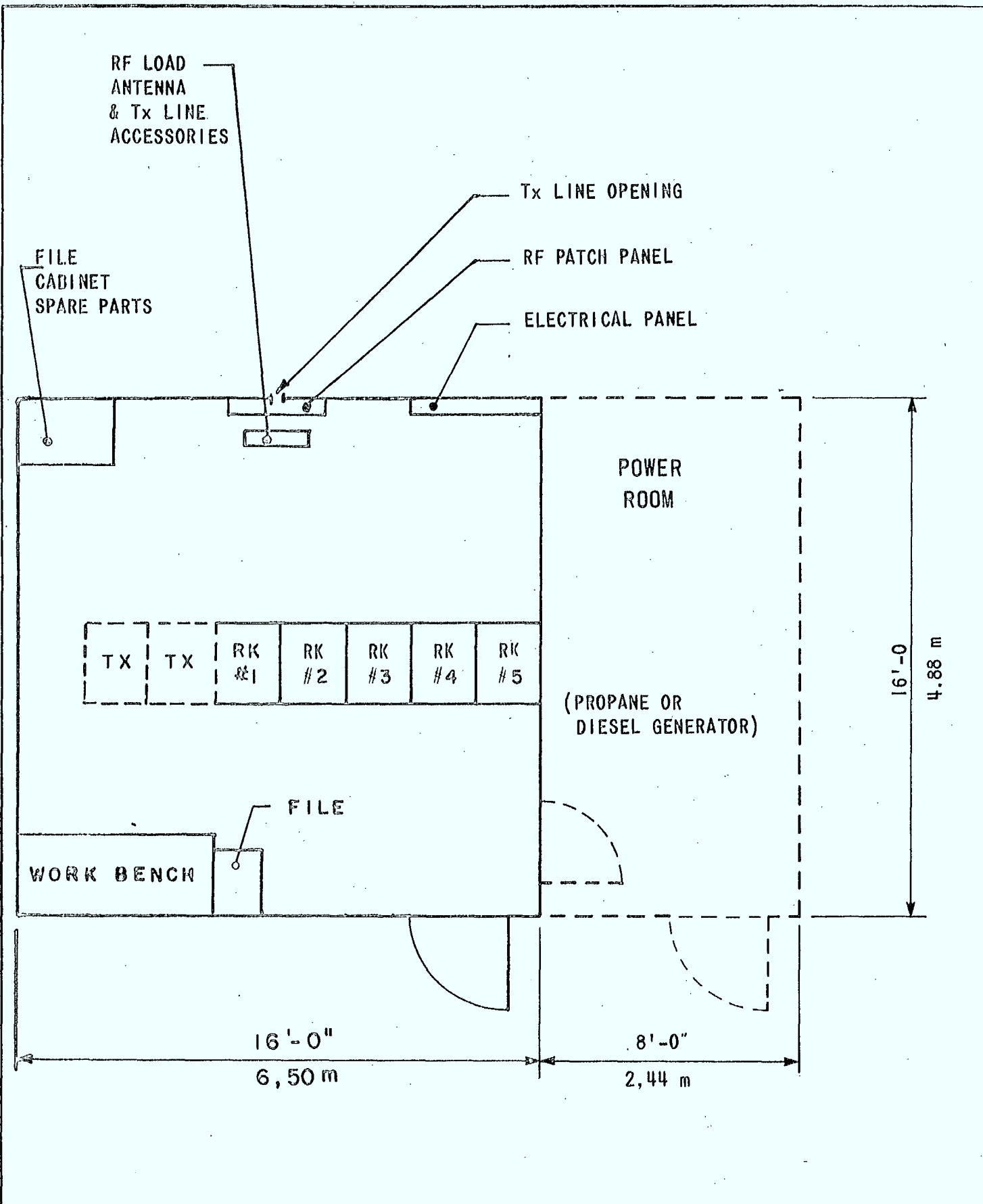
RF PATCH PANEL

ELECTRICAL PANEL



CLIENT		DEPARTMENT OF COMMUNICATIONS		FAIT/MADE	VERIFIE/CHKD	DATE	
PROJ.		MULTICHANNEL TV REBROADCAST STATIONS		R. FRENETTE	G. JOLIVET	1-02-79	
	FIG. 4 STANDARD SHELTER MODEL HOUSING PLAN - 4 CHANNELS-	APPR.		ECH./SCALE		DATE REV.	
		F. DI GIANDOMENICO		1/4" = 1'-0		6-07-79	
		CONTR.	SUBDIV.	ELEMENT	NO.	REV.	
		5285	0157	47 DD	04	01	

4000-11/0 FORMAT "A"



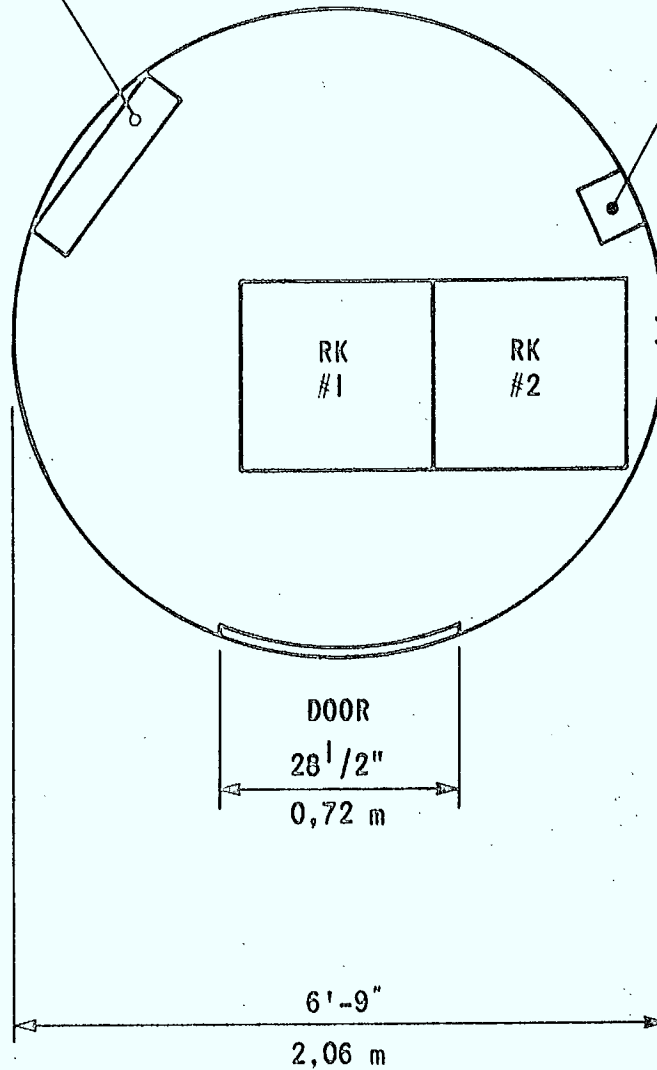
CLIENT		DEPARTMENT OF COMMUNICATIONS		FAIT/MADE	VERIFIE/CHKD	DATE	
PROJ.		MULTICHANNEL TV REBROADCAST STATIONS		R. FRENETTE	G. JOLIVET	1-02-79	
DXG	FIG. 5	STANDARD SHELTER MODEL HOUSING PLAN- 8 CHANNELS.		APPR.	ECH./SCALE	DATE REV.	
				F. GIANDOMENICO	1/4" = 1'-0	6-07-79	
				CONTR.	SUBDIV.	ELEMENT	NO. REV.
				5265	O 157	47 DD	05 01


4000-11/0 FORMAT "A"

ELECTRICAL
PANEL

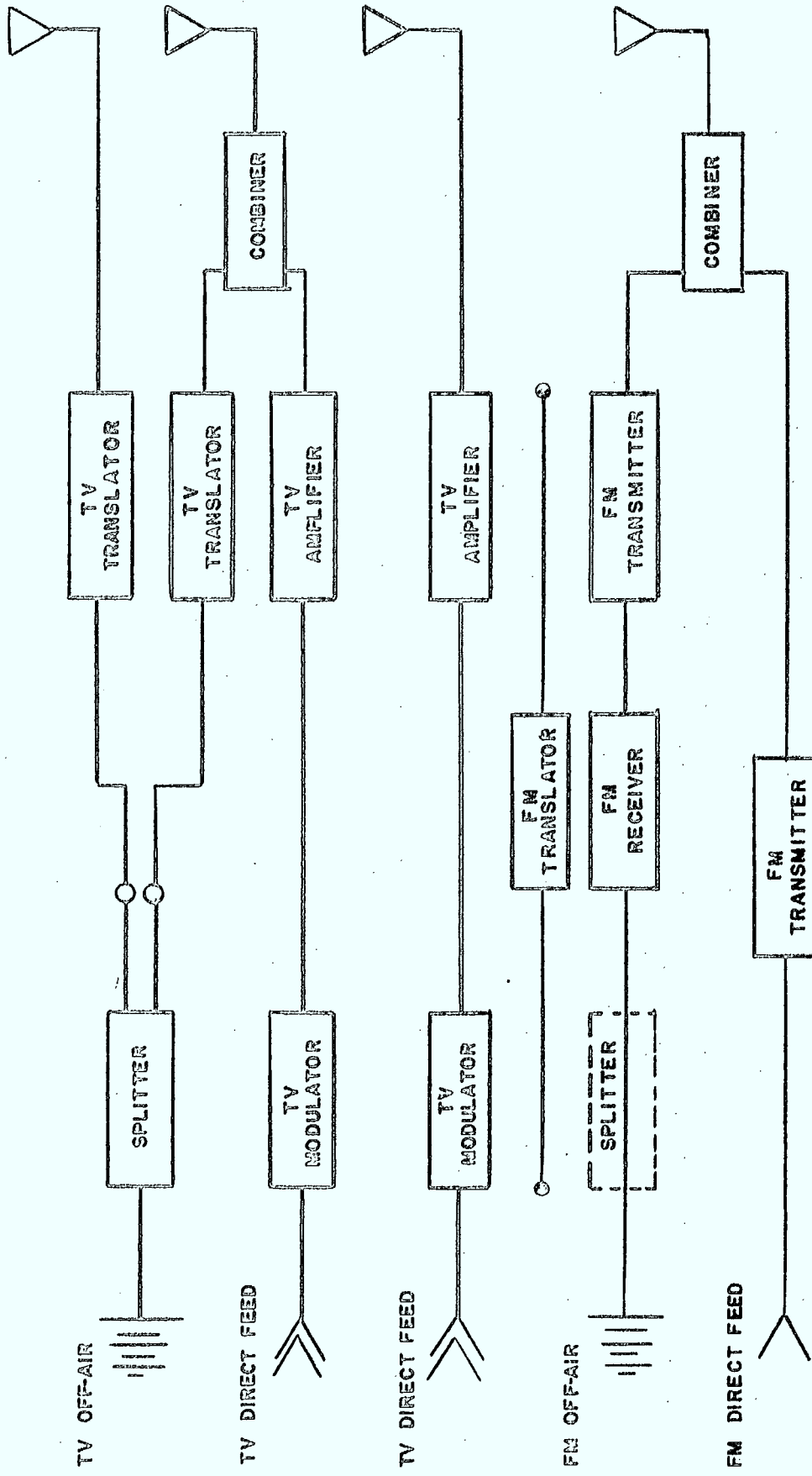
RF LOAD
ANTENNA
& Tx LINE
ACCESSORIES

Tx LINE
OPENING



CLIENT	DEPARTMENT OF COMMUNICATIONS	FAIT/MADE	VERIFIE/CHKD	DATE
PROJ.	MULTICHANNEL TV REBROADCAST STATIONS	R. FRENETTE	G. JOLIVET	1-02-79
	FIG. 6 SPECIALIZED SHELTER MODEL FLOOR PLAN	APPR.	ECH./SCALE	DATE REV.
		F. DI GIANDOMENICO	1/2" = 1'-0	6-07-79
		CONTR.	SUBDIV.	ELEMENT
5265	0157	47 DD	06	01

4000-11-5 FORMAT "A"



CLIENT DEPARTMENT OF COMMUNICATIONS MULTICHANNEL TV REDROADCAST STATIONS	FAIT/MADE R. HUPPE		VERIFIE/CHKD G. JOLIVET		DATE 1-02-79	
	APPR. F. GIANDOMENICO		ECH./SCALE		DATE REV. 6-07-79	
PROJ. FIG. 7 SIMPLIFIED FUNCTIONAL DIAGRAM BASIC 4 CHANNELS MODEL	CONTR. 52 65	SUBDIV. 0157	ELEMENT 47 DD		NO. 07	REV. 01

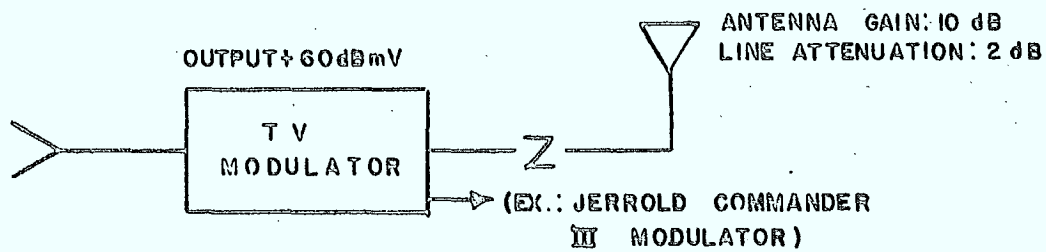


FIG. 8. BLOCK DIAGRAM OF TV MODULATOR ARRANGEMENT

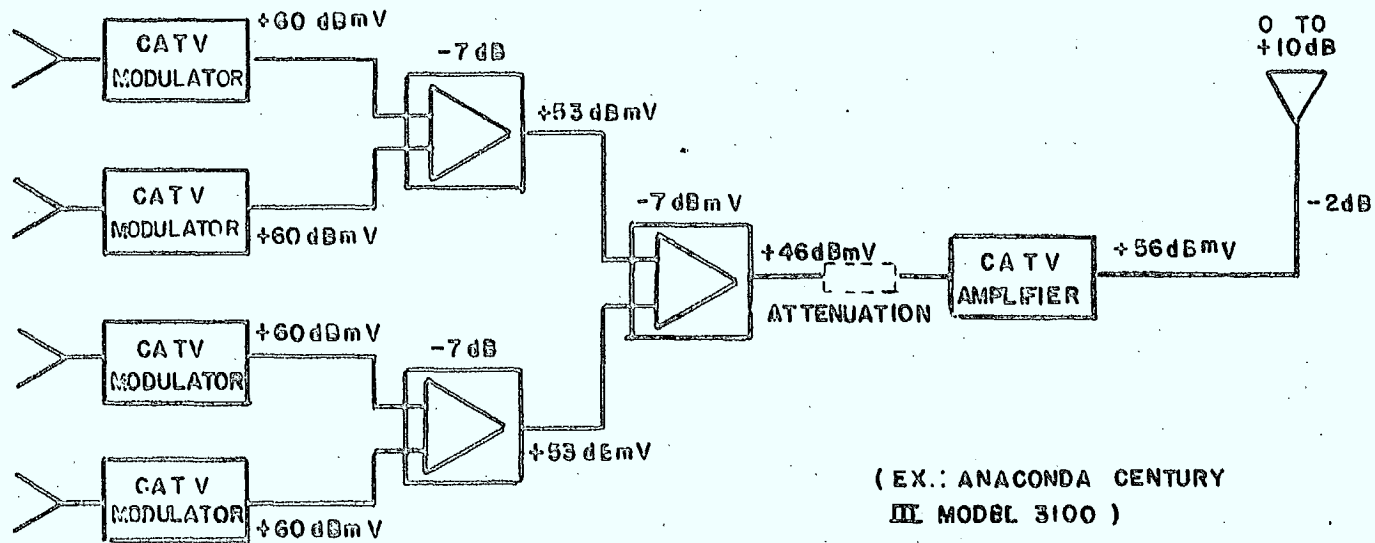
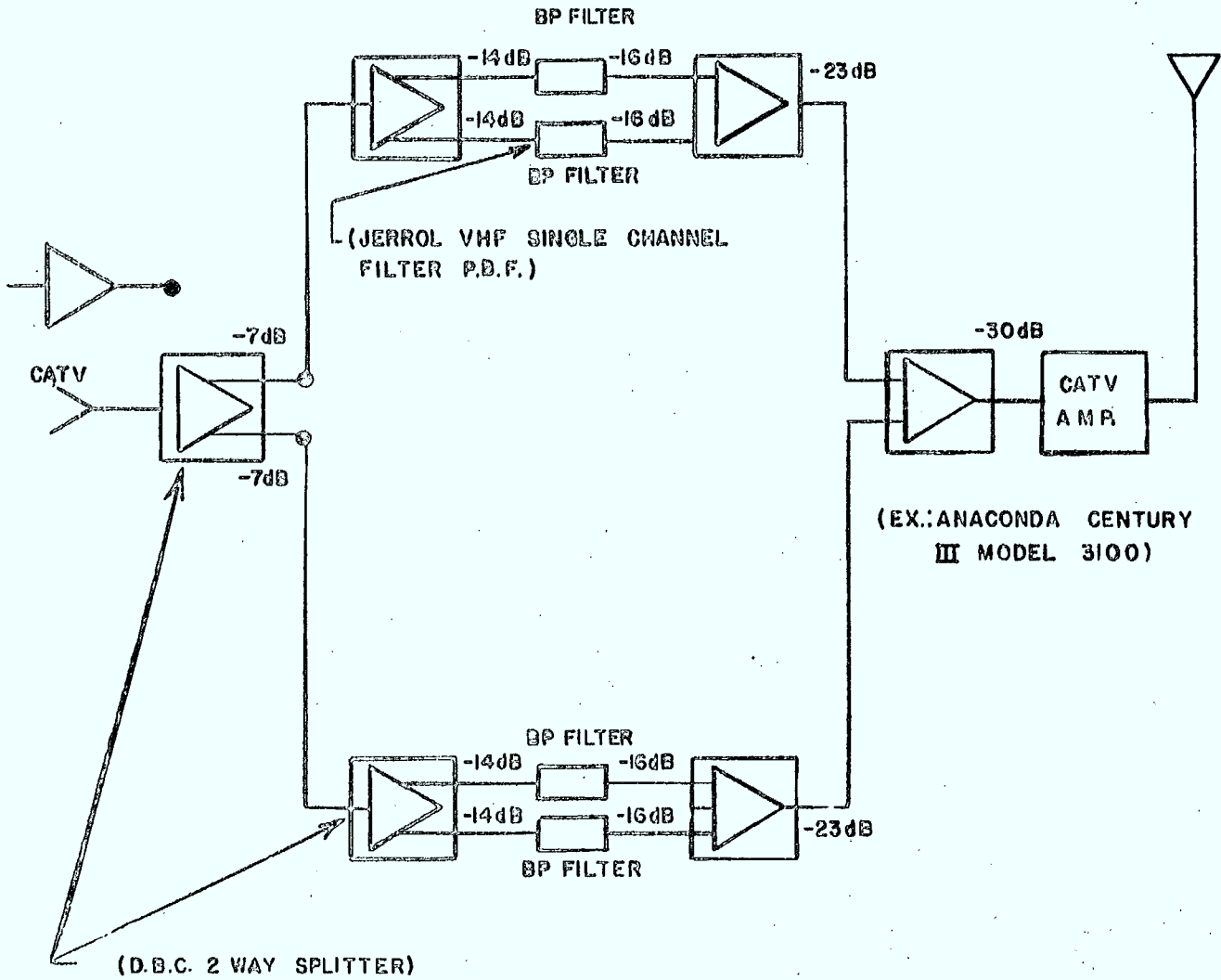


FIG. 9. BLOCK DIAGRAM OF CATV MODULATOR AMPLIFIER ARRANGEMENT

4000-11/VO FORMAT "A"

CLIENT		DEPARTMENT OF COMMUNICATIONS		FAIT/MADE		VERIFIE/CHKD		DATE	
PROJ.		MULTICHANNEL TV REBROADCAST STATIONS		R. HUPPE		G. JOLIVET		9-04-79	
FIG. SET 9		TV MODULATOR/ CATV AMPLIFIER ARRANGEMENT		APPR.		ECH./SCALE		DATE REV.	
DYG B				F. GIANDOMENICO				6-07-79	
				CONTR.		SUBDIV.		ELEMENT	
				5265		0157		47 DD	
								NO.	
								08/09	
								REV.	
								01	

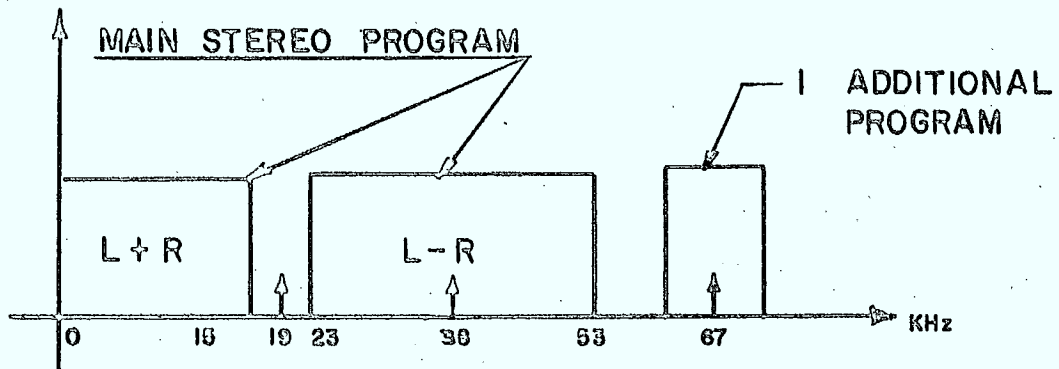
BLOCK DIAGRAM FOR BROADCASTING OF CATV FEED



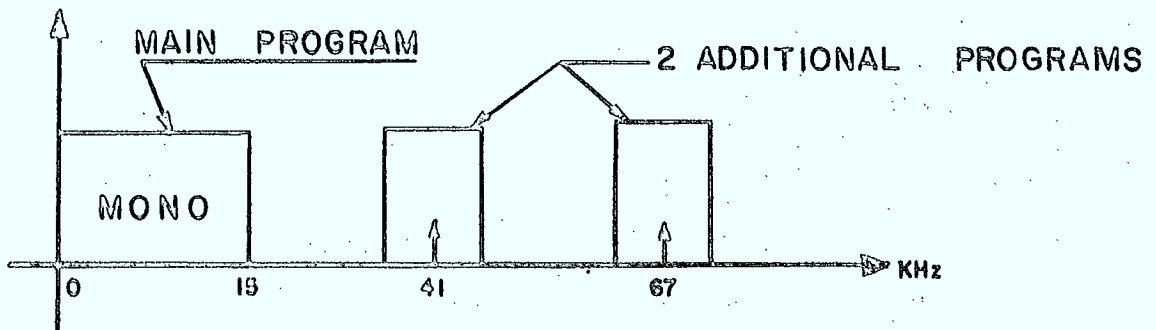
CLIENT		DEPARTMENT OF COMMUNICATIONS		FAIT/MADE	VERIFIE/CHKD	DATE	
PROJ.		MULTICHANNEL TV REBROADCAST STATIONS		R. HUPPE	G. JOLIVET	9-04-79	
DYG		FIG. 10		APPR.	ECH./SCALE	DATE REV.	
BLOCK DIAGRAM FOR BROADCASTING OF CATV FEED.		F. GIANDOMENICO				6-07-79	
CONTR.	SUBDIV.	ELEMENT		NO.	REV.		
5265	0157	47DD		10	01		

4600-11/00 FORMAT "A"

• FM STEREO- SPECTRUM



• FM MONO- SPECTRUM



NOTE

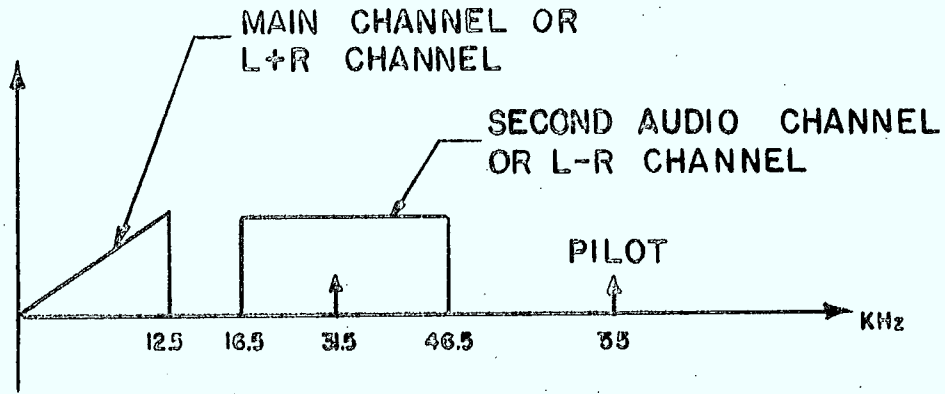
THE ADDITIONAL SUBCARRIERS ARE GENERALLY DEVIATED A MAXIMUM OF ± 6 KHz; THE MAIN CARRIER IS DEVIATED A MAXIMUM OF ± 75 KHz AS IN CONVENTIONAL OPERATION.

p. 44

4000-11/0 FORMAT 'A'

CLIENT DEPARTMENT OF COMMUNICATIONS MULTICHANNEL TV REBROADCAST STATIONS		FAIT/MADE R. HUPPE	VERIFIE/CHKD G. JOLIVET	DATE 9-04-79
PROJ. FIG. II FM STEREO AND MONO SPECTRA		APPR. F. GIANDOMENICO	ECH./SCALE	DATE REV. 6-07-79
		CONTR. 5265	SUBDIV. 0157	ELEMENT 47 DD
			NO. 11	REV. 01

PROPOSED 2 CHANNEL
AUDIO SPECTRUM FOR TV

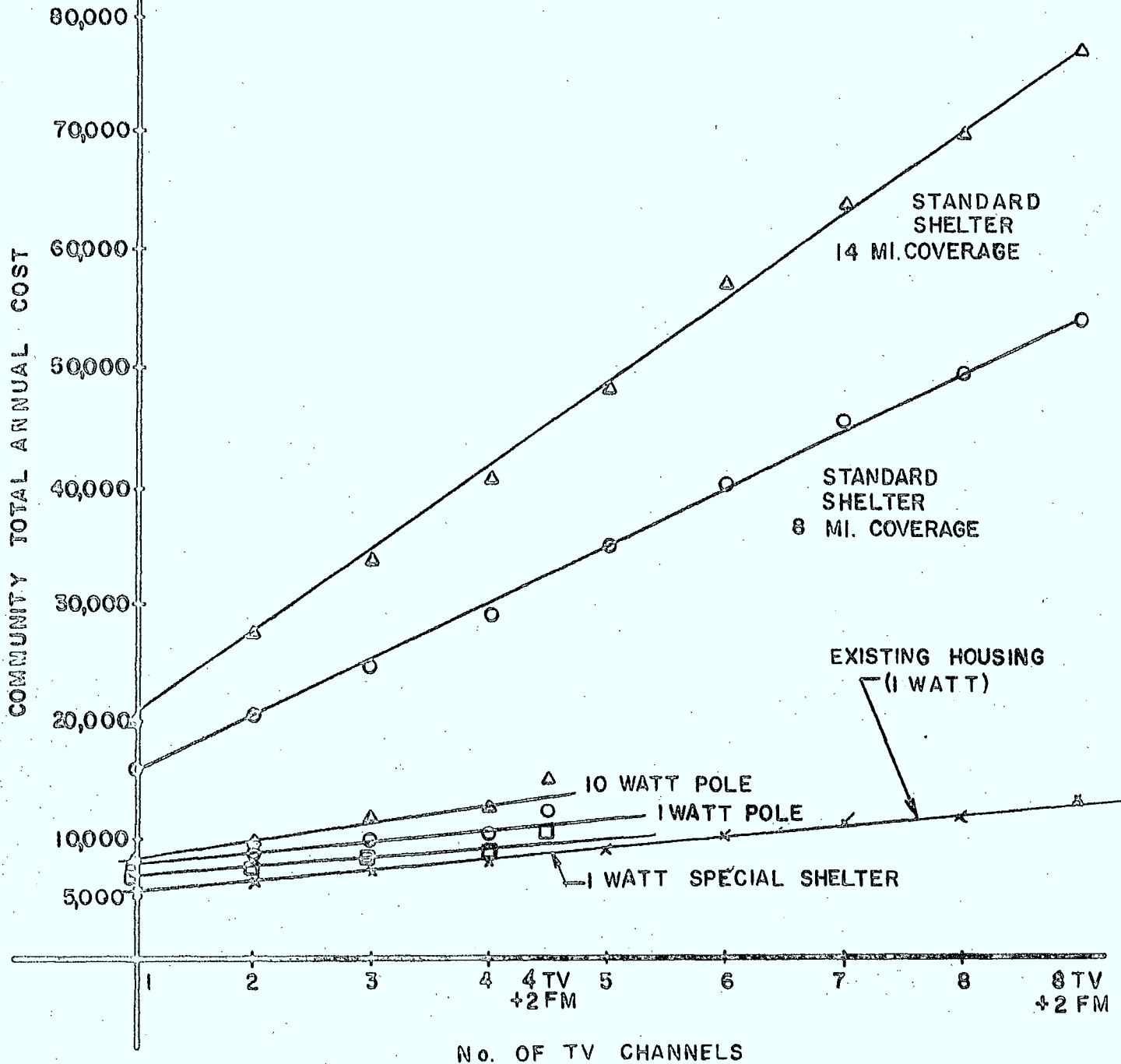


NOTE

THE MAIN CARRIER IS DEVIATED
A MAXIMUM OF ± 25 KHz AS
IN CONVENTIONAL OPERATION.

CLIENT DEPARTMENT OF COMMUNICATIONS		FAIT/MADE R. HUPPE		VERIFIE/CHKD G. JOLIVET		DATE 9-04-79		
PROJ. MULTICHANNEL TV REBROADCAST STATIONS		APPR. F. GIANDOMENICO		ECH./SCALE		DATE REV. 6-07-79		
OXGIB	FIG. 12	PROPOSED 2 CHANNEL AUDIO SPECTRUM FOR TV		CONTR.	SUBDIV.	ELEMENT	NO.	REV.
		5265	0157	47 DD	12	01		

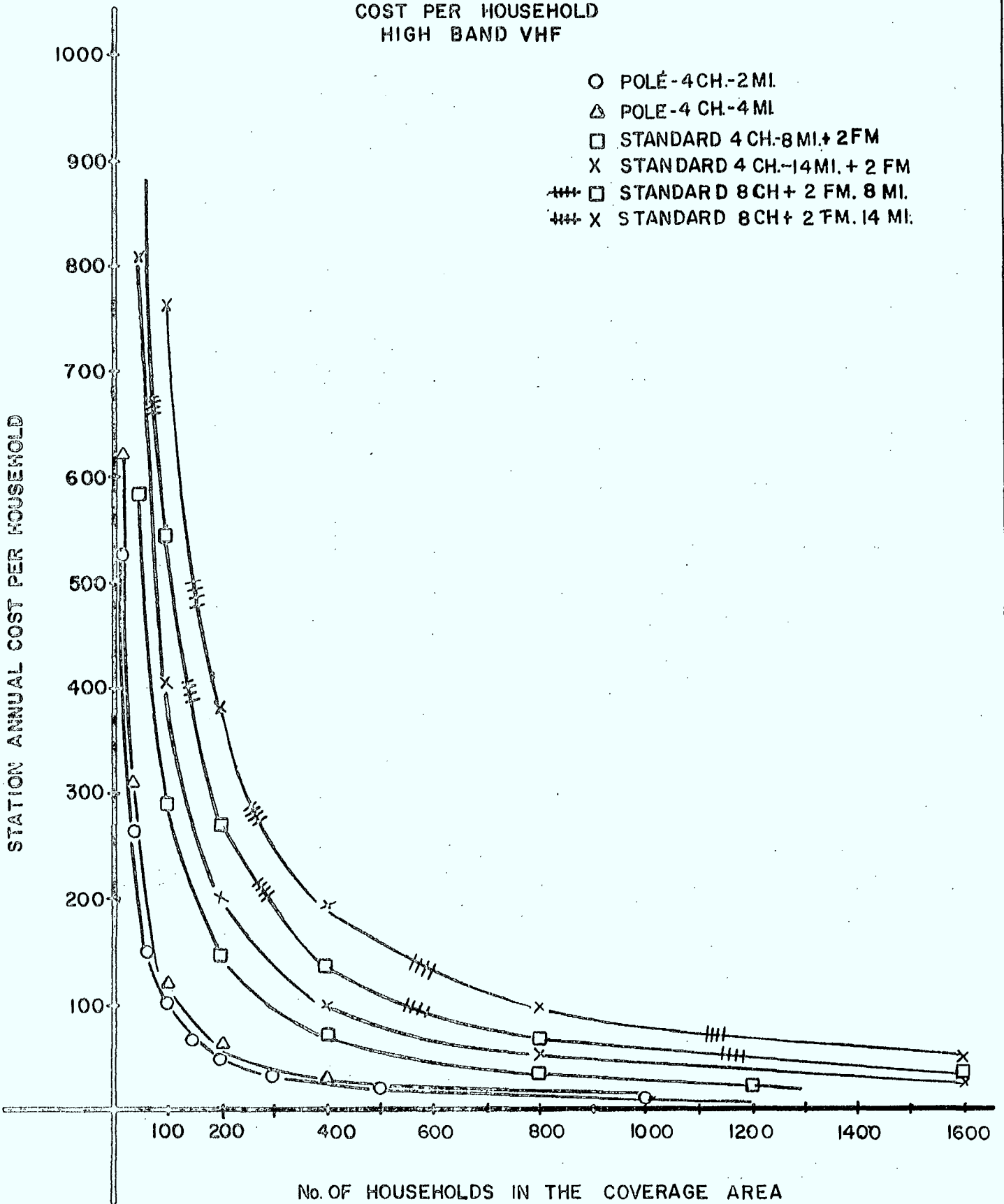
BASIC MODEL COSTS
HIGH BAND VHF



No. OF TV CHANNELS

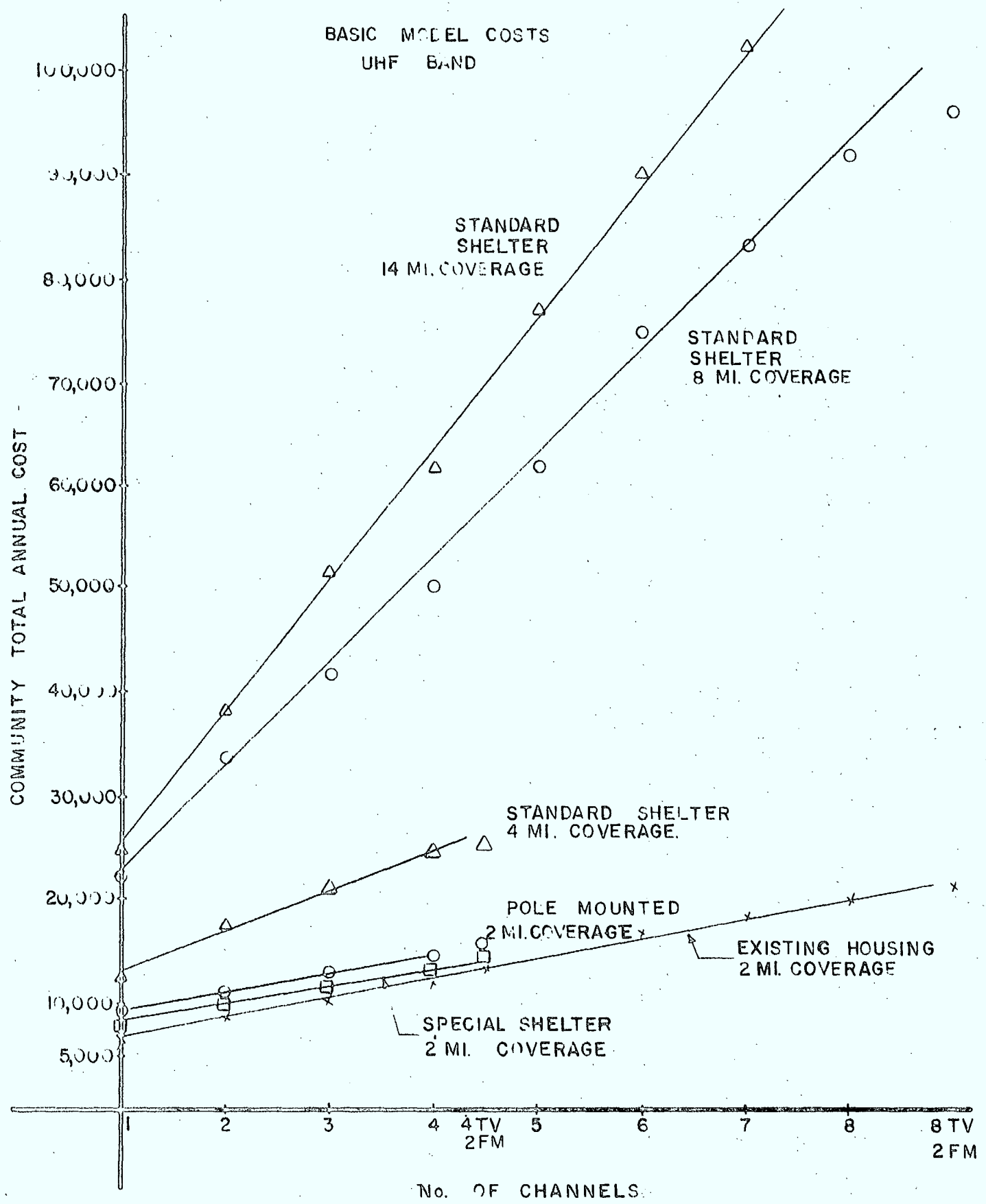
CLIENT	DEPARTMENT OF COMMUNICATIONS	FAIT/MADE	R. HUPPÉ	VERIFIE/CHKD	G. JOLIVET	DATE	1-02-79
	PROJ. MULTICHANNEL TV REBROADCAST STATIONS	APPR.	F. GIANDOMENICO	ECH./SCALE		DATE REV.	9-07-79
FIG. 13	BASIC MODEL COSTS HIGH BAND VHF	CONTR.	5265	SUBDIV.	0157	ELEMENT	47 DD
						NO.	13
						REV	01

COST PER HOUSEHOLD
HIGH BAND VHF



4000-11/0 FORMAT 'A'

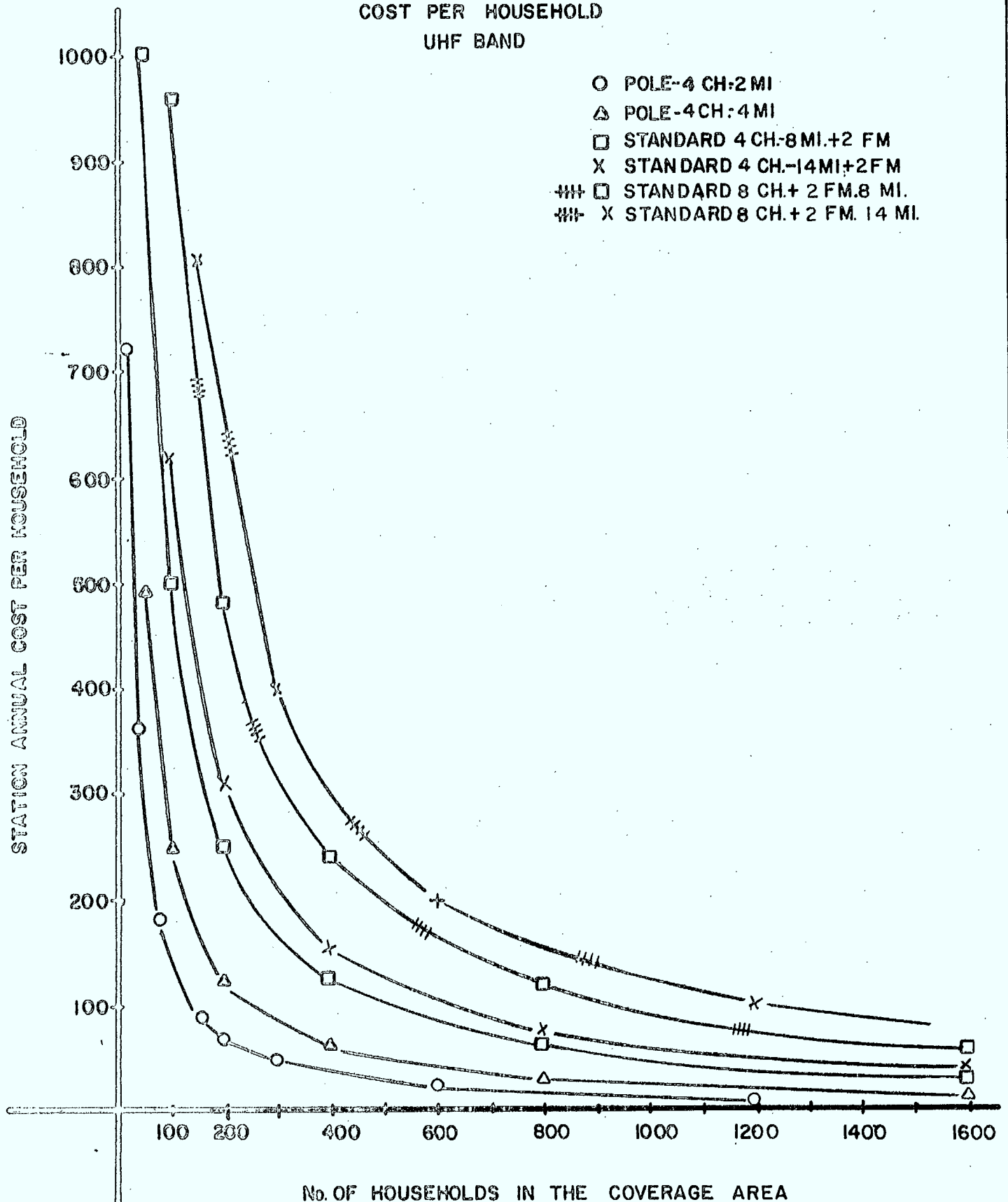
CLIENT DEPARTMENT OF COMMUNICATIONS		FAIT/MADE R. HUPPÉ		VERIFIE/CHKD G. JOLIVET		DATE 1-02-79	
PROJ. MULTICHANNEL TV REBROADCAST STATIONS		APPR. F. GIANDOMENICO		ECH./SCALE		DATE REV. 9-07-79	
	FIG. 14 COST PER HOUSEHOLD HIGH BAND VHF	CONTR.	SUBDIV.	ELEMENT		NO.	REV.
		5265	0157	47 DD		14	01



3006-11/0 FORMAT A

CLIENT DEPARTMENT OF COMMUNICATIONS MULTICHANNEL TV REBROADCAST STATIONS		FAIT-MADE R. HUPPÉ		VERIFIÉ/CHKD G. JOLIVET		DATE 1-02-79	
		APPR. F. GIANDOMENICO		ECH. SCALE		DATE REV 9-07-79	
	FIG. 15 BASIC MODEL COSTS UHF BAND	CONTR	SUBDIV.	ELEMENT	NO	REV	
		5265	0157	47 DD	15	01	

**COST PER HOUSEHOLD
UHF BAND**



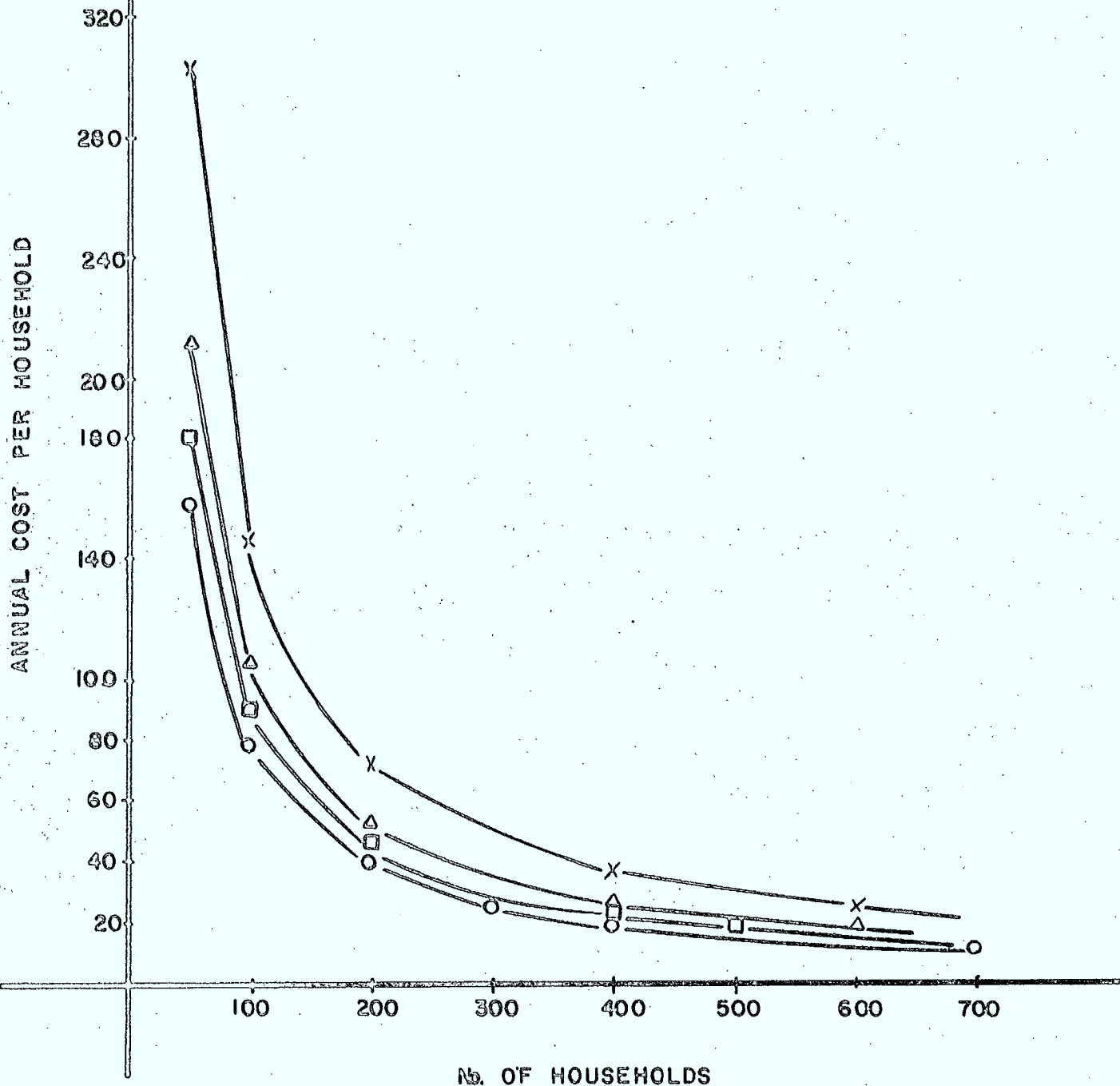
No. OF HOUSEHOLDS IN THE COVERAGE AREA

2000-11-10 FORMAT "A"

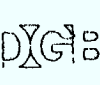
CLIENT DEPARTMENT OF COMMUNICATIONS		FAIT/MADE R. HUPPÉ	VERIFIE/CHKD. G. JOLIVET	DATE 1-02-79
PROJ. MULTICHANNEL TV REBROADCAST STATIONS		APPR. F. GIANDOMENICO	ECH./SCALE	DATE REV 9-07-79
	FIG.16 COST PER HOUSEHOLD UHF BAND	CONTR. 5265	SUBDIV. 0157	ELEMENT 47 DD
		NO. 16	REV 01	

COST PER HOUSEHOLD
POLE MOUNTED, 1 WATT

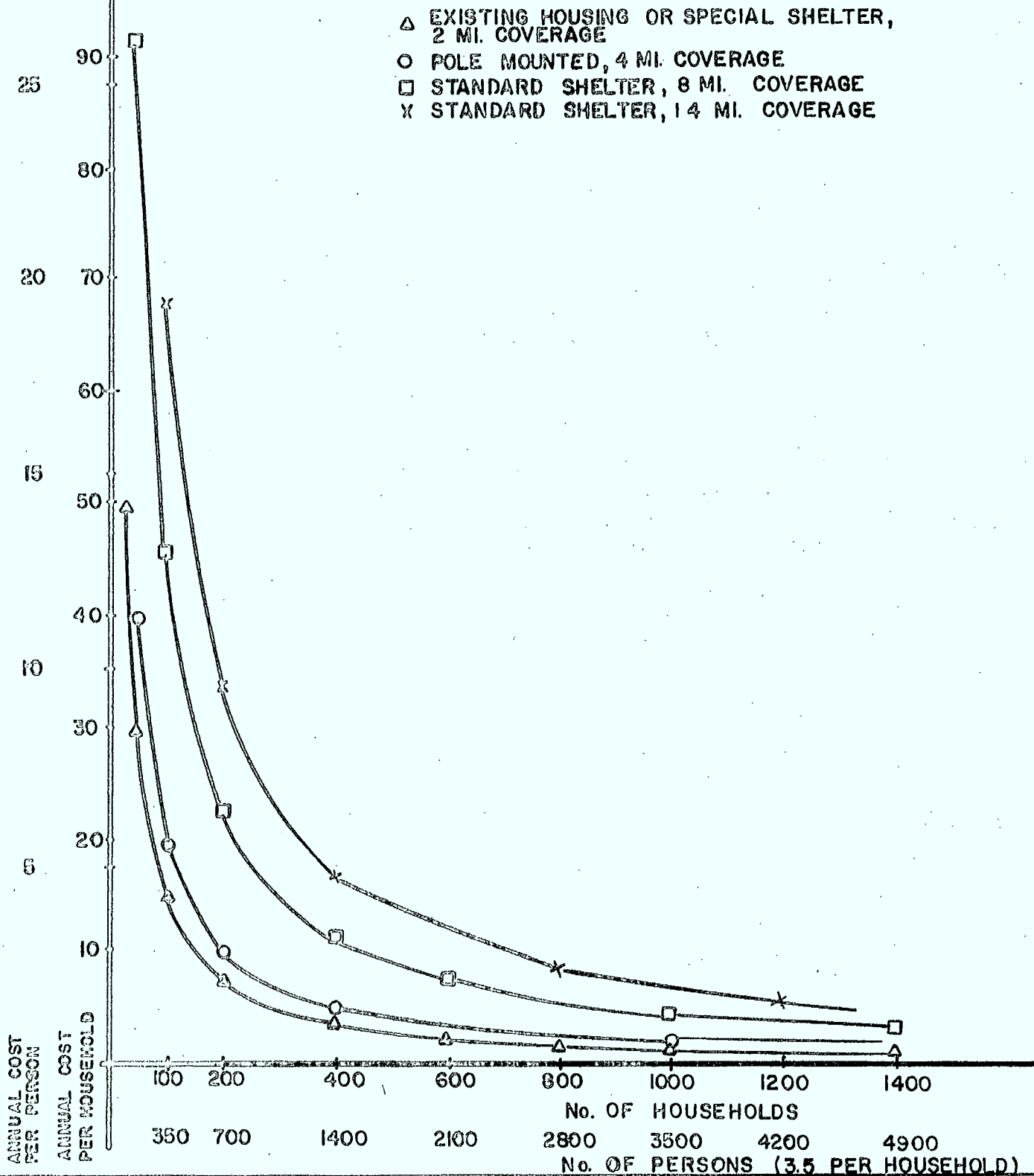
- 1 TV CH. HI-VHF.
- △ 4 TV CH. HI-VHF.
- 1 TV CH. UHF.
- × 4 TV CH. UHF.



4000-11/0 FORMAT "A"

CLIENT DEPARTMENT OF COMMUNICATIONS MULTICHANNEL TV REDBROADCAST STATIONS	FAIT/MADE R. HUPPÉ		VERIFIE/CHKD G. JOLIVET		DATE 1-02-79	
	APPR. F. GIANDOMENICO		ECH./SCALE		DATE REV. 9-07-79	
 FIG.17 COST PER HOUSEHOLD 1 WATT POLE MOUNTED, MODEL	CONTR.	SUBDIV.	ELEMENT		NO.	REV.
	5265	0157	47 DD		17	01

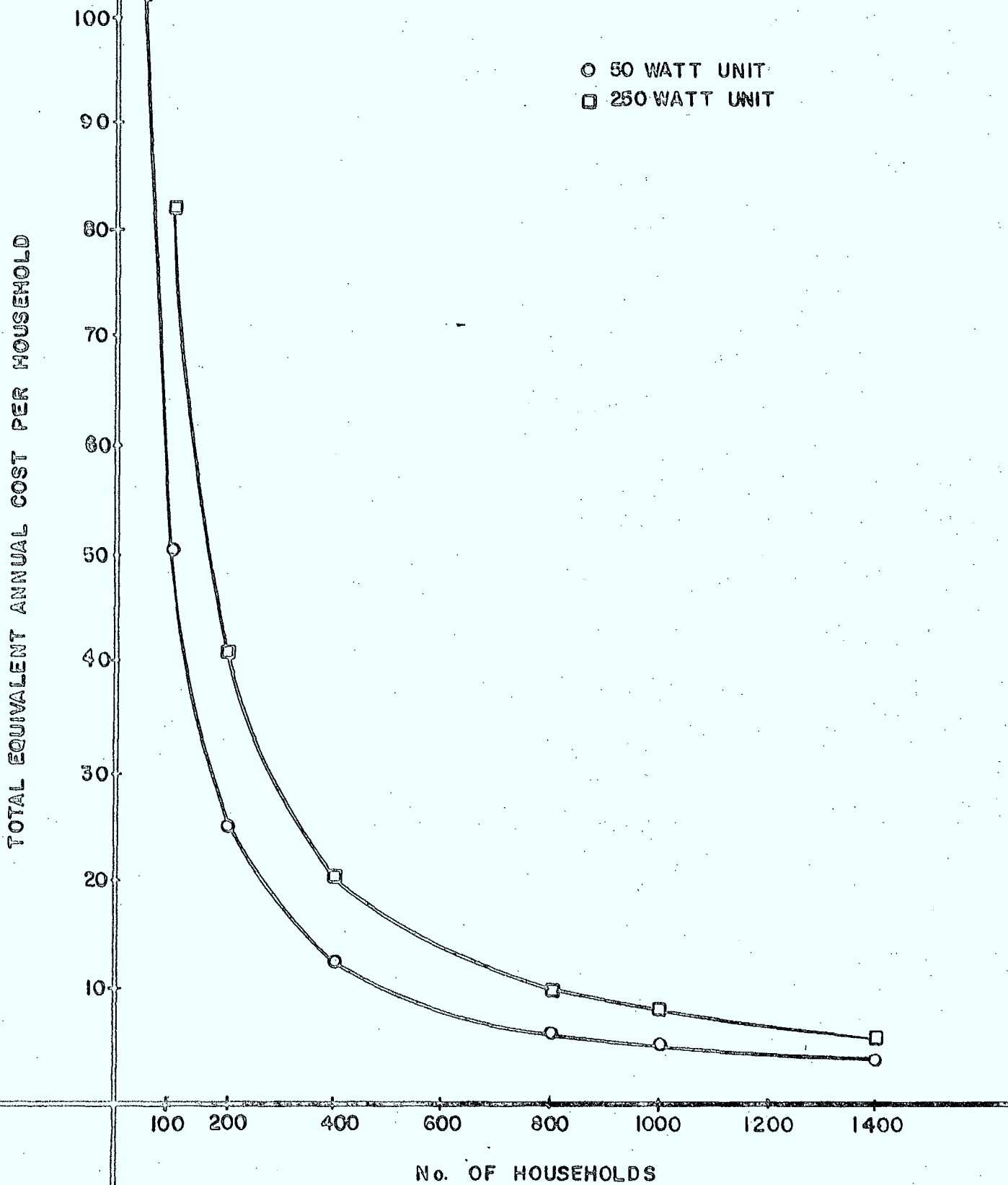
MARGINAL COST FOR 2 FM CHANNELS



5060-110 FORMAT "A"

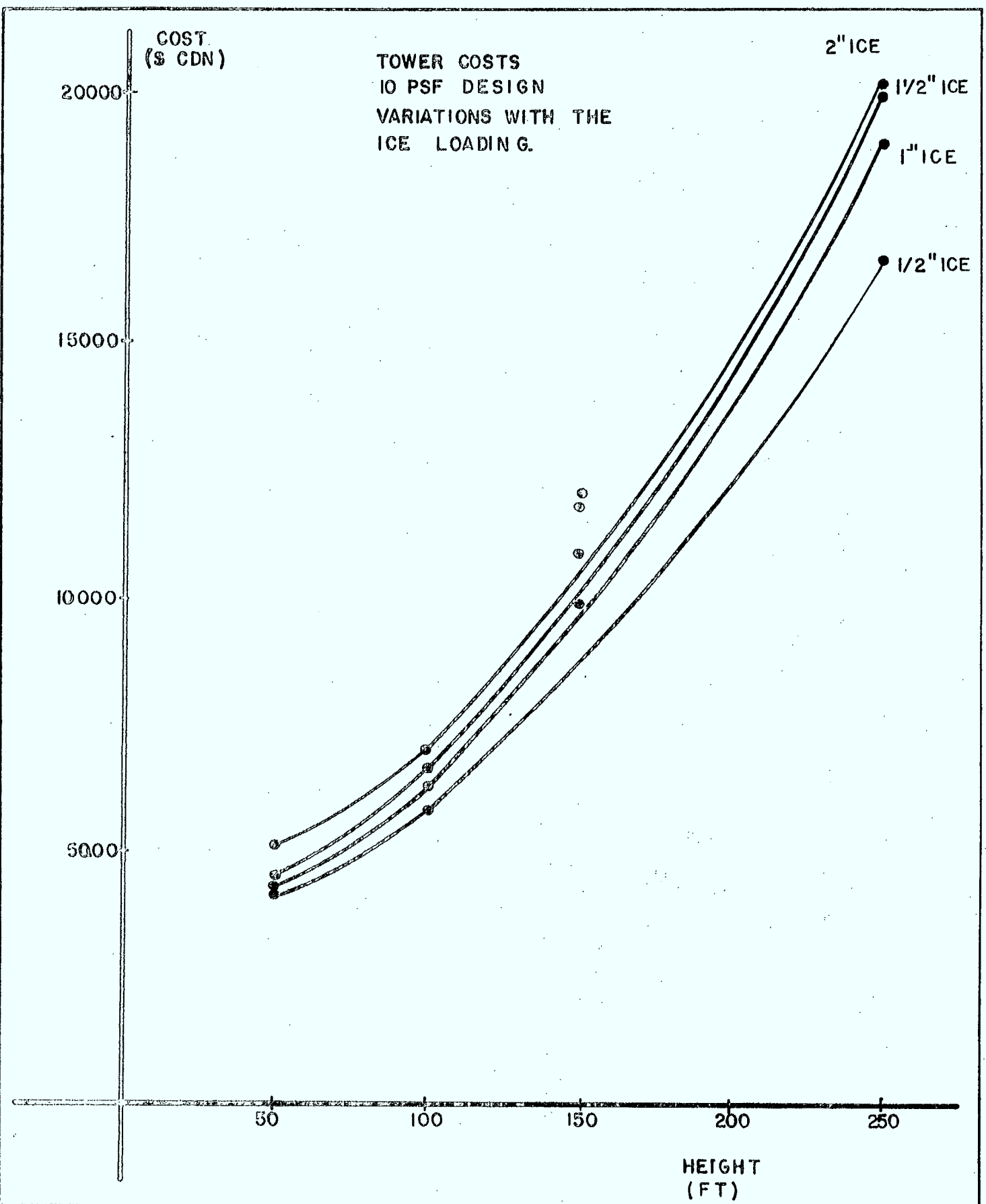
CLIENT	DEPARTMENT OF COMMUNICATIONS		FAIT/MADE	VERIFIE/CHKD	DATE		
	MULTICHANNEL TV REBROADCAST STATIONS		R. HUPPE	G. JOLIVET	1-02-79		
PROJ.	FIG. 18. MARGINAL COST FOR 2 FM CHANNELS		APPR.	ECH./SCALE	DATE REV.		
			F. GIANDOMENICO		9-07-79		
			CONTR.	SUBDIV.	ELEMENT	NO.	REV.
			5265	0157	47 DD	18	01

COST FOR 1 AM RADIO CHANNEL



4000-110 FORMAT "A"

CLIENT	DEPARTMENT OF COMMUNICATIONS		FAIT/MADE	VERIFIE/CHKD	DATE		
	MULTICHANNEL TV REDBROADCAST STATIONS		R. HUPPE	G. JOLIVET	1-02-79		
PROJ.	FIG.19 COST FOR 1 AM RADIO CHANNEL		APPR.	ECH./SCALE	DATE REV.		
			F.GIANDOMENICO		9-07-79		
			CONTR.	SUBDIV.	ELEMENT	NO.	REV.
			5265	0157	47 DD	19	01



4000-1100 FORMAT "A"

CLIENT DEPARTMENT OF COMMUNICATIONS		FAIT/MADE R. HUPPÉ	VERIFIE/CHKD G. JOLIVET	DATE 1-02-79	
PROJ. MULTICHANNEL TV REBROADCAST STATIONS		APPR. F. GIANDOMENICO	ECH./SCALE	DATE REV. 9-07-79	
	FIG. 20 TOWER COSTS-10 PSF DESIGN VARIATIONS WITH THE ICE LOADING	CDNTR. 5265	SUBDIV. 0157	ELEMENT 47 DD	NO. 20
				REV 01	

COST
(\$ CDN)

TOWER COSTS
13 PSF DESIGN
VARIATIONS WITH THE
ICE LOADING

20000

15000

10000

5000

2" ICE

1 1/2" ICE

1" ICE

1/2" ICE

50

100

150

200

250

HEIGHT
(FT)

CLIENT DEPARTMENT OF COMMUNICATIONS
PROJ. MULTICHANNEL TV REBROADCAST STATIONS

FAIT/MADE
R. HUPPÉ

VERIFIE/CHKD
G. JOLIVET

DATE
1-02-79

APPR.
F. GIANDOMENICO

ECH./SCALE

DATE REV.
9-07-79

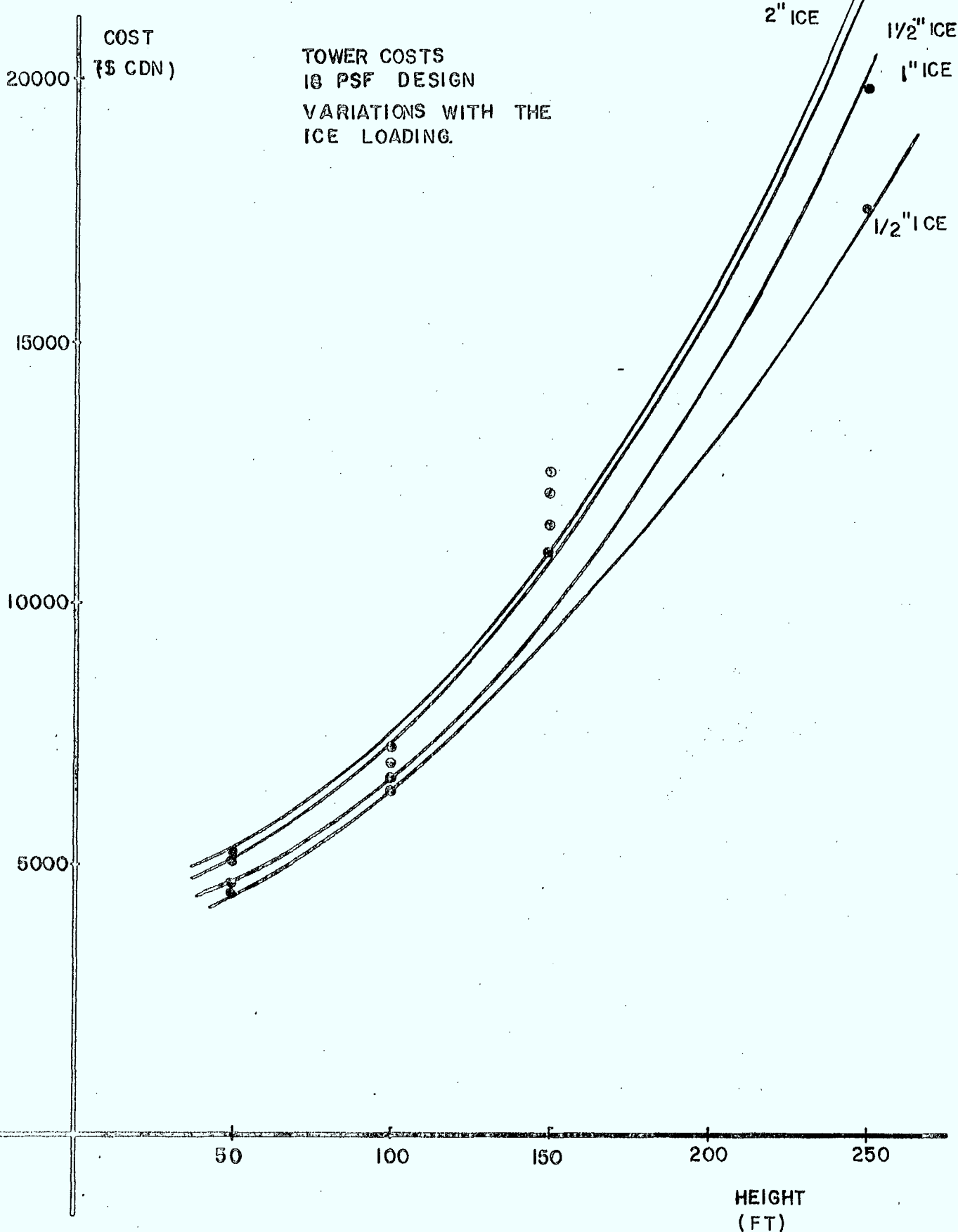
FIG. 21 TOWER COSTS - 13 PSF DESIGN
VARIATIONS WITH THE ICE LOADING

CONTR. SUBDIV.
5265 0157

ELEMENT
47 DD

NO. REV.
21 01

TOWER COSTS
18 PSF DESIGN
VARIATIONS WITH THE
ICE LOADING.



2000-1100 FORMAT "A"

CLIENT	DEPARTMENT OF COMMUNICATIONS	
PROJ.	MULTICHANNEL TV REBROADCAST STATIONS	
FIG. 22	TOWER COSTS-18 PSF DESIGN	
	VARIATIONS WITH THE ICE LOADING	

FAIT/MADE	R. HUPPÉ	VERIFIE/CHKD	G. JOLIVET	DATE	1-02-79
APPR.	F. GIANDOMENICO	ECH./SCALE		DATE REV.	9-07-79
CONTR.	5265	SUBDIV.	0157	ELEMENT	47 DD
				NO.	22
				REV	01

COST
(\$ CDN)

TOWER COSTS
1 IN. ICE LOADING
VARIATIONS WITH DESIGN

8 PSF
13 PSF
10 PSF

20000

15000

10000

5000

50

100

150

200

250

HEIGHT
(FT)

CLIENT	DEPARTMENT OF COMMUNICATIONS		FAIT/MADE	VERIFIE/CHKD	DATE
	MULTICHANNEL TV REBROADCAST STATIONS		R. HUPPE	G. JOLIVET	1-02-79
PROJ.	FIG. 23 TOWER COSTS - 1 IN. ICE LOADING VARIATIONS WITH DESIGN.		APPR.	ECH./SCALE	DATE REV.
			F. GIANDOMENICO		9-07-79
DCI	CONTR.	SUBDIV.	ELEMENT	NO.	REV
	5265	0157	47 DD	23	01

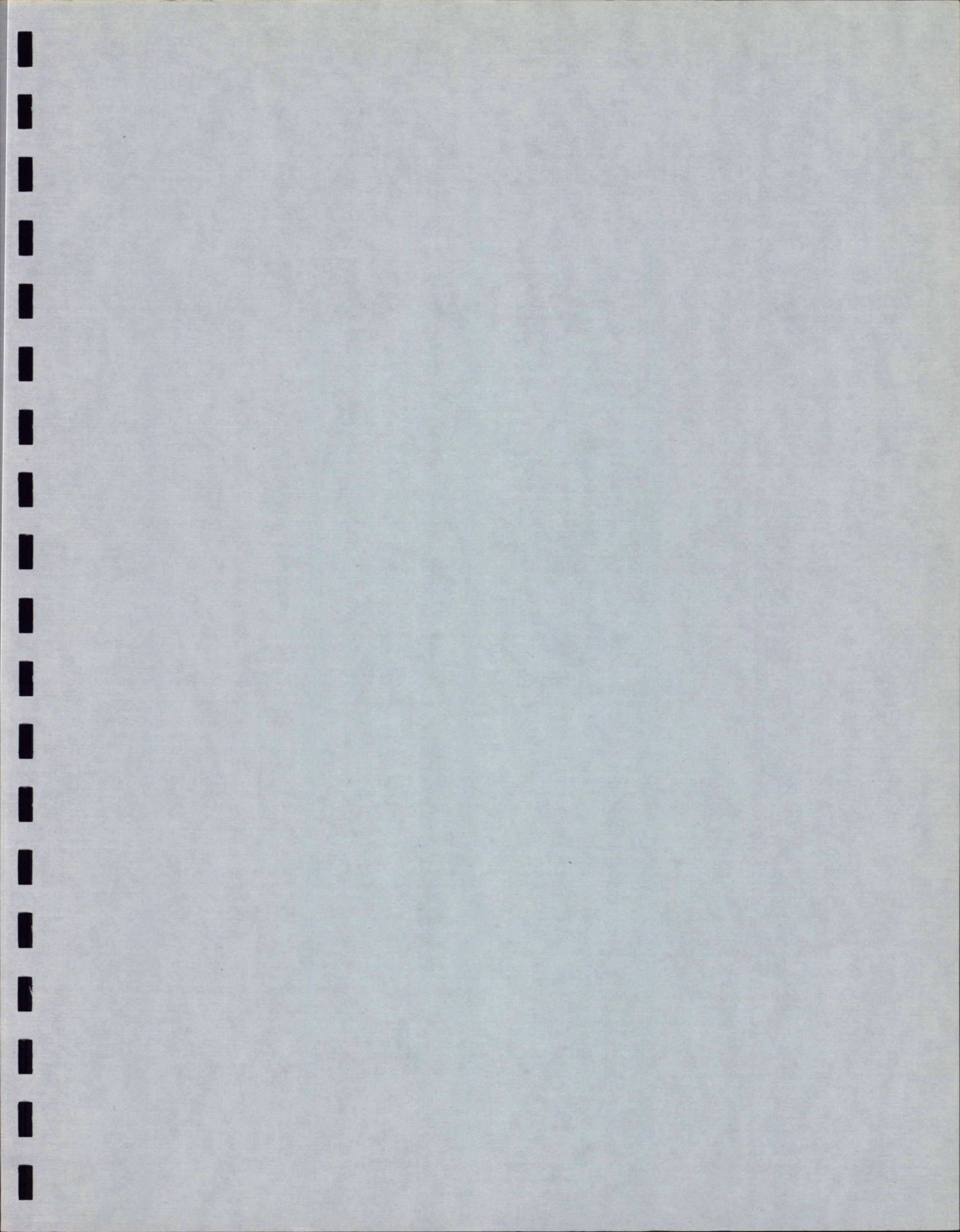
4000-11/70 FORMAT "A"

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- APPENDIX A -

ORDER OF MAGNITUDE ESTIMATE

FOR

CIVIL, ELECTRICAL AND MECHANICAL WORKS

DCB

**D
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B**

DSS/DOC - MCTV: REPORTS	79/07/23	1	5265-0154	1/15
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		VERIFIE/VERIFIED	VISA	
		G. Jolivet		
		APPROUVE/APPROVED	VISA	
		C. Azevedo		

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1. BASIS OF ESTIMATE

1.1 General

This feasibility estimate has been prepared as part of a feasibility study for the Department of Communications. It covers the cost for the civil, mechanical and electrical work.

1.2 The formation of the estimate

There are four (4) basic models, as described in Section 6 of the report. Each model has been broken down into several items.

In the variations, attached to each basic model, the item is estimated and cross-referenced to the item in the basic model.

When applying the variation to the basic model, the cost of the item listed in the basic model should be deducted from the total of the basic model and the cost of the variation added. This method applies to all four models.

1.3 Prices

Verbal quotations were received from contractors for the major items in this estimate eg. towers, buildings, roads, site clearing, generators.

All prices are current prices prevailing in the Province of Quebec.

1.4 Labour

It is assumed that wherever possible labour work will be performed by local inhabitants, except where skilled labour is required.

1.5 Regional construction cost indices

All prices are the current prices prevailing in the Province of Quebec. In order to derive the cost of construction of the other regions the following factors or cost indices should be applied to the "base" Quebec costs.

Quebec (Base)	100%
Maritimes	103%
Newfoundland	110%
Ontario	104%
Prairies	101%
British Columbia	112%

The above indices of factors were derived from "Lansdown's Construction Cost Handbook 1978" by David K. Lansdown and Partners Ltd.

The figures above are to be used as a guide only. The person or organization who will eventually estimate the cost of a site in his locality would have to use his discretion.

1.6 Assumptions

In view of the fact that the exact location of sites, condition of each site, the number of sites, etc. were unknown at the time of this estimate, several assumptions were made, and are listed below:

1. Access Roads: a) Clearing of trees, etc, - 20' wide strip.
b) Gravel for base is available within a radius of 10 miles of each site.
2. Building: a) Buildings are pre-cut requiring site assembling of panels.
b) Heated, ventilated, grounded
c) Rests on concrete slab on grade.
3. Diesel Generator: a) Include generator, shelter, tank and all accessories.
b) Pre-assembled unit complete with steel framed shelter.
c) Tank capacity 2 months supply based on continuous operation.
4. Towers: All towers include: a) Foundations
b) Installation of antennae
c) Electrical work including grounding

1.7 Estimate exclusions

1. Escalation
2. All engineering including project management
3. Cost of Land
4. Royalties
5. Permits
6. Legal fees
7. Start-up & commissioning
8. Electronic equipment
9. Supply of antennae & accessories
10. Spare parts, repair tools

1.8 Quotations from contractors

The following is a list of companies which submitted quotations:

1. Steel Towers
(Verbal quotations)
 - Communication Tower Service Co.
11430 - 6th Ave., R.D.P., Montreal
Mr. J. Melfi
 - Maxtower Co. Ltd
5 Edmonson, Brantford, Ontario
Mr. W. Dirks
2. Wood Poles
(Verbal quotation)
 - Perrault & Perrault Ltee
5126 Iberville, Montreal
3. Aluminium Poles
(Verbal quotation)
 - Air Distribution Equipment Inc.
10780 Pascal Gagnon, Montreal
Mr. Levesque

4. Diesel Generators (Verbal quotation) - Coneng Quebec
8530 Delmeade, Montreal
Mr. Sorenson
5. Thermo Electric Generators (Written quotation) - Mechron Engineering Products Ltd.
90B Brunswick Blvd.
Dollard des Ormeaux, Montreal
Mr. R.G. Bell
6. Solar Panels - Lucas Industries Canada Ltd.
280 Yorkland Boulevard
Willowdale, Ontario
Mr. J. Noble
7. Roads and Site Clearing (Verbal quotation) - Simard-Beaudry Division de Corpex
(1977) Inc.
3033 Jarry East, Montreal
Mr. J. Henault
8. Comshel (Verbal quotation) - Sinclair Radio Laboratories Ltd.
719 Lajoie, Dorval, Quebec
Mr. M. Duhamel
9. Helicopter Rental (Verbal quotation) - Canadian Helicopters Ltd.
9501 Ryan, Dorval, Québec
Mr. Parent

2. CAPITAL COST ESTIMATE

2.1 Basic model No.1 - Pole mounted model

2.1.1 Cost breakdown

ITEM NO.	ITEM DESCRIPTION	QUEBEC - BASE - \$
1.1	<u>SITE PREPARATION</u>	
1.1.1	Minor site clearance	500.
1.2	<u>TOWER</u>	
1.2.1	Wood pole 12"0 x 50' high	300.
1.2.2	Pole foundations	1,500.
1.2.3	Guy wires and foundations	
1.2.4	Supply electronic equipment	-
1.2.5	Install 2 antennae & 1 "box" on pole	400.
1.2.6	Steel support on pole for "box"	300.
1.3	<u>ELECTRICAL</u>	
1.3.1	New powerline - assume 200'	2,000.
1.3.2	Tower elec. incl. grounding	1,500.
1.3.3	Elec. to equipment	300.

1.4 MECHANICAL

1.5 FENCING

Safety fence - assume 40'

600.

TOTAL BASIC MODEL NO.1

7,400.

2.1.2 Variations to basic model No.1

<u>ITEM DESCRIPTION</u>	<u>BASIC MODEL ITEM NO.</u>	<u>QUEBEC - BASE - TOTAL \$</u>
1. Concrete base to support three equip. boxes i.l.o. mounting them on the pole-incl.conc., excav., back-fill, re-bar, anchor bolts.	1.2.6	600.
2. Wood pole 80' high i.l.o. 50' incl. stronger foundations, and increased electrical work.	1.2.1	1,500.
3. Aluminium pole 100' high incl. stronger foundations and increased electrical work.	1.2.1	9,000.
4. Access road for 4 wheel drive vehicle or skidoo (during winter) - in good soil with no forestation - including clearing and grubbing, cut and fill, gravel base, culverts.	-	83,000. per mile
5. Clear site covered with bushes and trees, level and provide gravel base, 100' x 100'.	1.1.1	3,500.
6. Provide hydro-power from exist. source incl. poles, transformer and all cables.	-	14,000. per mile
7. Install four (i.l.o. two) high band VHF antennae on:		
a) 50' pole	1.2.5	600.
b) 80' pole	1.2.5	600.
c) 100' pole	1.2.5	600.
8. Provide two 30' high poles spaced 200' apart to support wire antennae; incl. foundations, and installation of wire antennae.	1.2.1 1.2.2 1.2.3 1.2.5 1.2.6	2,700.

2.2 BASIC MODEL NO.2 - STANDARD SHELTER MODEL

2.2.1 Cost breakdown

<u>ITEM NO.</u>	<u>ITEM DESCRIPTION</u>	<u>QUEBEC - BASE - \$</u>
2.1	<u>SITE PREPARATION</u>	
2.1.1	Minor site clearance	500.
2.2	<u>BUILDING</u>	
2.2.1	Prefabricated building incl. foundations H & V, elec. - size 12' x 12'	10,800.
2.3	<u>TOWER - 10 PSF WIND, 1/2" ICE</u>	
2.3.1	Foundations	600.
2.3.2	Steel tower with guys	} 7,600.
2.3.3	Install tower	
2.3.4	Install 4 antennas	
2.4	<u>ELECTRICAL</u>	
2.4.1	Powerline incl. transformer - 200'	2,000.
2.4.2	Tower elec. & grounding	2,500.
2.4.3	Elec. to equipment	300.
2.5	<u>FENCING</u>	
2.5.1	Safety fence - assume 40'	600.
	TOTAL BASIC MODEL 2	<u>\$24,900.</u>

2.2.2 Variations to basic model No.2

<u>ITEM DESCRIPTION</u>	<u>BASIC MODEL ITEM NO.</u>	<u>QUEBEC - BASE - TOTAL \$</u>
1. Access road for 4 wheel drive vehicle or skidoo (during winter) including clearing and grubbing, cut and fill, gravel base, culverts, in:		
a) Rocky soil - no forest	-	112,000. per mile
b) Good soil - no forest	-	83,000. per mile
c) Rocky soil - medium f.	-	118,000. per mile
d) Good soil - medium f.	-	88,000. per mile
2. Pre-cut building incl. founds., electrical, H & V., bench, size:		
a) 8' x 12'	2.2.1	7,200.
b) 16' x 16'	2.2.1	19,200.
3. Log cabin built with materials available locally size 16' x 16'.	2.2.1	17,900.
4. Clear and prepare site for towers in rocky terrain with medium forests for:		
a) 50' tower - 80' x 80'	2.1.1	3,800.
b) 100' tower - 150' x 130'	2.1.1	7,000.
c) 150' tower - 200' x 200'	2.1.1	9,000.
d) 250' tower - 300' x 300'	2.1.1	14,000.
5. Clear and prepare site for towers in good soil with medium forest for:		
a) 50' tower - 80' x 80'	2.1.1	2,200.
b) 100' tower - 150' x 130'	2.1.1	4,500.
c) 150' tower - 200' x 200'	2.1.1	6,500.
d) 250' tower - 300' x 300'	2.1.1	11,500.
6. New hydro power line from exist. source incl. poles, founds., cables, transformer and accessories in:		
a) Good soil	2.4.1	12,000.
b) Rocky soil	2.4.1	16,000.

2.2.2 Variations to basic model No.2 (Cont'd)

<u>ITEM DESCRIPTION</u>	<u>BASIC MODEL ITEM NO.</u>	<u>QUEBEC - BASE - TOTAL \$</u>
7. Diesel generator, shelter, tank, tank stand and necessary accessories:		
a) 1 - 5 kw	2.4.1	15,300.
b) 5 - 10 kw	2.4.1	19,000.
c) 10 - 15 kw	2.4.1	22,400.
d) 15 - 25 kw	2.4.1	28,200.
e) 25 - 30 kw	2.4.1	39,000.
8. Thermo-electric generators incl. shelter, fuel tanks and necessary accessories:		
a) 8 watts	2.4.1	10,000.
b) 16 "	2.4.1	10,700.
c) 24 "	2.4.1	11,700.
d) 37 "	2.4.1	12,600.
e) 50 "	2.4.1	13,700.
f) 58 "	2.4.1	14,700.
g) 64 "	2.4.1	15,700.
h) 75 "	2.4.1	16,900.
i) 88 "	2.4.1	17,800.
9. Solar power generator incl. solar array, frame, supports, voltage regulator, foundations, batteries and battery housing:		
a) 100 watt unit	2.4.1	34,000.
b) 300 watt unit	2.4.1	80,200.

2.2.2 Variations to basic model No.2 (Cont'd)

<u>ITEM DESCRIPTION</u>	<u>BASIC MODEL ITEM NO.</u>	<u>QUEBEC - BASE - TOTAL \$</u>
10. Steel guyed tower including foundations and installation of 4 antennae.		
a) 1/2 " ice and 13 psf. wind loading.		
30' high 15" tower	2.3.2	2,900.
50' high "	2.3.3	3,400.
60' high "	2.3.4	4,500.
80' high "	"	5,900.
100' high 20" tower	"	6,200.
150' high "	"	10,500.
200' high "	"	14,600.
Where 8 antennae are required add \$500 to tower cost.		
b) 1" ice and 18 psf wind loading		
100' high 24" tower	"	6,700.
150' high "	"	11,500.
200' high "	"	17,100.
c) 1 1/2" ice and 18 psf wind loading.		
100' high 24" tower	"	7,000.
150' high "	"	12,100.
200' high "	"	17,900.

2.3 BASIC MODEL NO.3 - SPECIALIZED SHELTER MODEL2.3.1 Cost breakdown

<u>ITEM NO.</u>	<u>ITEM DESCRIPTION</u>	<u>QUEBEC - BASE - \$</u>
3.1	<u>SITE PREPARATION</u>	
3.1.1	Minor site clearance	200.
3.2	<u>BUILDING</u>	
3.2.1	Specialized shelter (comshel) incl. foundations, elec. 7'Ø x 28' high	10,000.
3.3	<u>TOWER</u>	
3.3.1	Mast 25' high placed inside comshel	} 1,000.
3.3.2	Install mast	
3.3.3	Transport mast	
3.3.4	Install antennas	
3.4	<u>ELECTRICAL</u>	
3.4.1	Diesel generator with shelter and tank - 1 kw	15,300.
3.4.2	Tower elec. incl. grounding	800.
3.4.3	Elec. to equipment	300.
3.5	<u>FENCING</u>	
3.5.1	Safety fence - assume 40'	600.
	TOTAL BASIC MODEL 3	<hr/> \$28,200.

2.3.2 Variations to basic model No.3

<u>ITEM DESCRIPTION</u>	<u>BASIC MODEL ITEM NO.</u>	<u>QUEBEC - BASE - TOTAL \$</u>
1. Specialized housing (comshel)	3.2.1	} 9,900.
7'Ø x 8' high incl. founds.,	3.3.1	
bench, electrical and 30'	3.3.2	
high mast	3.3.3	
	3.3.4	
2. Do with 60' high mast	Do	10,700.
3. Clear site covered with bushes and trees 100' x 100' in:		
a) Good soil	3.1.1	3,500.
b) Rocky soil	3.1.1	6,000.
4. Helicopter rental incl. pilot, engineer, fuel, insurances:		
a) Lift capacity 4,500 lbs	-	800. per hour
b) 4 place personnel carrier	-	300. per hour
N.B. 1- In both cases a) & b) the minimum rental time is 2 to 4 hours depending on time of year.		
2- Charge applies to flying time only. No charge when helicopter is stationary.		

2.4 BASIC MODEL NO.4 - EXISTING HOUSING MODEL2.4.1 Cost breakdown

<u>ITEM NO.</u>	<u>ITEM DESCRIPTION</u>	<u>QUEBEC - BASE - \$</u>
4.1	<u>SITE PREPARATION</u>	
4.1.1	Minor site clearance	-
4.2	<u>BUILDINGS</u>	
4.2.1	Provide workbenches, shelves, etc.	500.
4.3	<u>MAST</u>	
4.3.1	Modify existing roof for antennas	} 800.
4.3.2	Mast and base	
4.3.3	Install antennas	
4.4	<u>ELECTRICAL</u>	
4.4.1	Elec. work to equipment, mast and grounding - from existing source	1,500.
	TOTAL BASIC MODEL 4	<hr/> \$2,800.

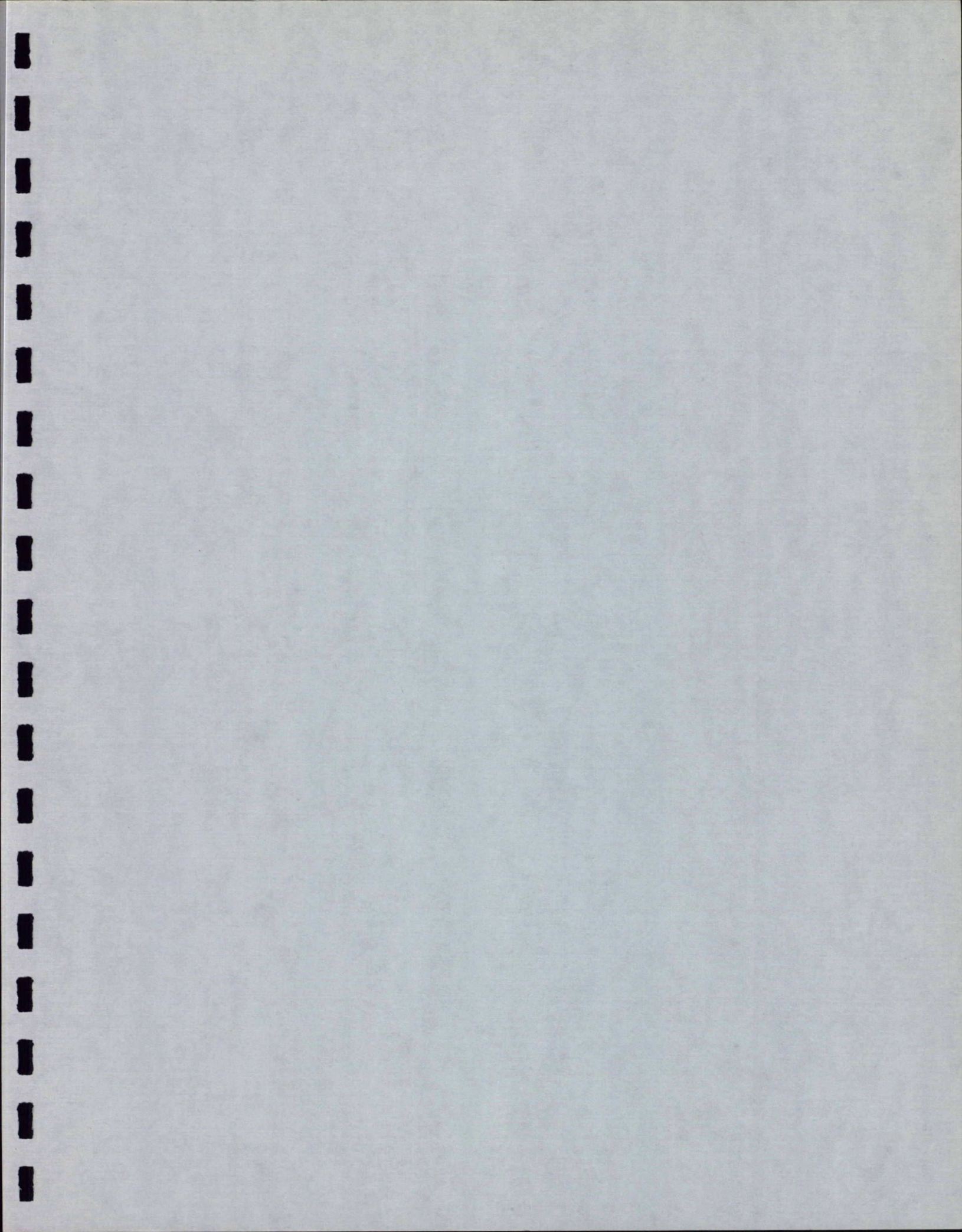
2.4.2 Variations to basic model No.4

<u>ITEM DESCRIPTION</u>	<u>BASIC MODEL ITEM NO.</u>	<u>QUEBEC - BASE - TOTAL \$</u>	
1. Provide additional building to accomodate equipment, etc. incl. found., electrical H & V, grounding - size 10' x 12'.	-	9,000.	
2. Provide antennae mount on exist. building roof to accomodate:			
a) 4 antennae	4.3.2	600.	
b) 8 antennae	4.3.2	800.	
3. Reinforce existing guyed steel tower and install antennae.	4.3.1 4.3.2 4.3.3	} allow 2000.	
4. Increase the existing power capacity at the existing site by installing a new diesel generator complete with shelter and tanks:			
a) 1 - 5 kw	-		15,300.
b) 15 - 25 kw	-	28,200.	
5. Modify the existing building ventilation.	-	1,500.	

3. ANNUAL RECURRING COST ESTIMATE

The following annual recurring or operating cost estimates are all based on land transportation of fuel.

		<u>QUEBEC BASE</u> <u>\$ per annum</u>
1.	Site Preparation	300.
2.	Roads	3,000. per mile
3.	Towers	1,500.
4.	Buildings	600.
5.	Diesel Generators:	
	(Cost includes fuel and 3 maintenance visits p.a.)	
	1- 5 kW	4,100.
	5-10 kW	5,900.
	10-15 kW	9,400.
	15-25 kW	16,300.
	25-30 kW	23,700.
6.	Thermoelectric Generators:	
	(Cost includes fuel and 1 maintenance visit p.a.)	
	8 Watts	1,400.
	16 Watts	1,500.
	24 Watts	1,600.
	37 Watts	1,800.
	50 Watts	1,900.
	58 Watts	2,000.
	64 Watts	2,100.
	75 Watts	2,200.
	88 Watts	2,300.
7.	Solar Generators (4 maintenance visits p.a.)	2,400.
8.	Hydro Power	200. per kW p.a.



- APPENDIX B -

COST ESTIMATES FOR ELECTRONIC EQUIPMENT

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		APPROUVE/APPROVED		VISA
		D.Y. Zann		

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1. BASIS OF ESTIMATE

1.1 General

The electronic equipment costs have been prepared as a part of a feasibility study for the Department of Communications; they are merged in the final report with the civil, mechanical and electrical costs.

Costs have been developed for the four basic models, as defined in section 6 of the report and also for several variations to these models, variations which have been brought by taking into account some of the considerations listed below.

Elements of maintenance costs to help derive the capital cost estimates are attached as a reference only; an estimate for a standard home receiving installation is also attached.

1.2 Coverage

Costs have been determined according to different Grade B coverages (2 miles, 4 miles, 8 miles and 14 miles) for the four models, considering height, frequency band and terrain roughness, and also taking into account other considerations such as use of environmental enclosures, special shelter, off-air receiving, power, directional antennae, transmission lines, etc.

Coverage objectives will be met using the equipment as stated, but it should be noted that other arrangements are possible, employing different combinations of transmitter power, transmission line and antenna gain. This could result in a lower cost for the rebroadcast station.

1.3 Frequency band

The H-VHF band has been taken as a reference, because it is a good compromise between the L-VHF and UHF bands in terms of propagation. Variations in costs due to the use of L-VHF or UHF bands are included.

1.4 Station layout

Schematic diagrams describe the station layout for each case subject to cost evaluation. They show three different modules for which the equipment cost is listed in detail.

1.5 Non-standard applications

Costs for non-standard applications such as use of a subcarrier, or use of a CATV amplifier for transmission are attached.

1.6 RF monitoring equipment

In order to lower costs, RF monitoring equipment such as waveform monitors, frequency meters, power meters, modulation meters, picture monitors and off-air monitors have not been included.

1.6 RF monitoring equipment (Cont'd)

Since the stations are expected to be unattended, a technician could provide the necessary monitoring and measuring equipment when necessary.

1.7 Miscellaneous equipment, testing and installation

Rounded figures have been used for miscellaneous equipment, such as cable connectors, cable hangers, jumpers and hardware; rounded figures have also been given for the cost of wiring, testing and installation.

1.8 Prices

Price lists and verbal quotations have been obtained from Canadian distributing companies. They are all referred to a Toronto base. Contingency and provincial taxes are not included.

1.9 Electronic equipment

This section includes a list of the electronic equipment considered in this study. Costs have been developed mainly with equipment of low to medium cost available on the market. In most cases two costs are given: one for low cost equipment, and one for medium cost equipment.

Cost for equipment deemed to be not essential such as preamplifiers, or audio limiters, have also been supplied.

Also included in appendix are four equipment rack layouts which show some possible arrangements of the above equipment in racks to be installed in the basic models.

DCI

1.9 Electronic equipment (Cont'd)

1. T.V. translators

- 1 watt, Rohde & Schwarz, HS-2061 and UT-010
- 1 watt, Television Technology Corp., T-99
- 1 watt, Acrodyne T-200
- 1 watt, EMCEE
- 5 watts, Rohde & Schwarz, UT-211
- 10 watts, Rohde & Schwarz, UT-211
- 10 watts, EMCEE
- 10 watts, Delta-Benco-Cascade, TS-010-D
- 10 watts, Acrodyne
- 50 watts, Rohde & Schwarz, UT-211
- 100 watts, Acrodyne, T-230
- 100 watts, EMCEE
- 500 watts, Acrodyne, T-237
- 1000 watts, Acrodyne, T-240
- 1000 watts, EMCEE

2. TV transmitters

- 1 watt, Acrodyne, TT-200
- 1 watt, EMCEE
- 10 watts, Delta-Benco-Cascade, TM-010
- 10 watts, EMCEE
- 10 watts, Acrodyne, TT-210
- 10 watts, EMCEE
- 100 watts, Acrodyne, TT-230
- 100 watts, EMCEE
- 1000 watts, Acrodyne, TT-340 VL
- 1000 watts, EMCEE

3. FM translators

- 1 watt, Television Technology Corporation, T-99 FMC
- 10 watts, Television Technology Corporation, T-99 FM-10C

4. FM transmitters

- 10 watts, CSI, FM-10ET
- 10 watts, QEI
- 10 watts, McMartin, B-910
- 10 watts, Sintronics
- 100 watts, CSI, FM-100E
- 100 watts, Sintronics
- 250 watts, CSI, T-25F
- 1000 watts, CSI, T-1-F
- 1000 watts, Sintronics

1.9 Electronic equipment (Con'd)

5. AM Transmitter

1, 4, 10, 20 and 50 watts, CSI Series T (a)

6. Carrier Current

1, 4, 10, 20 and 50 watts, CSI Series T (n)

7. TV equipment

- Triple Crown TV modulator
- Phasecom TV modulator
- TV modulator, Jerrold Commander II modulator
- TV receiver, Jerrold Commander II demodulator
- Linear VHF, TV amplifier, 5 watts, Television Technology A-110
- Linear UHF, TV amplifier, 10 watts, Acrodyne A-110V
- Wideband UHF-Wideband Amplifier, 7 watts, Acrodyne
- Wideband UHF, Amplifier 2 watts, Rohde & Schwarz

8. FM equipment

- RF amplifier, 5 watts, Television Technology, T-990-FMC

9. Miscellaneous equipment

- Audio limiter, Thomson-CSF, Volumax 4101/4111
- Receiving antennae, Lindsay, 10LE2
- Signal splitters, Lindsay, LS2E
- RF filter, Texcan
- Directional coupler, Bird 4152K
- RF power sensor, Bird 4161 W, dielectric
- Transmitting antennae, Sinclair SRL-106-TVC, Bogner BVP
- Combiners, Kathrein, Dielectric, Sinclair
- TV monitor, Sony, Electrohome, Conrac
- AM/FM monitor, McMartin

DCI

2. COST ESTIMATE

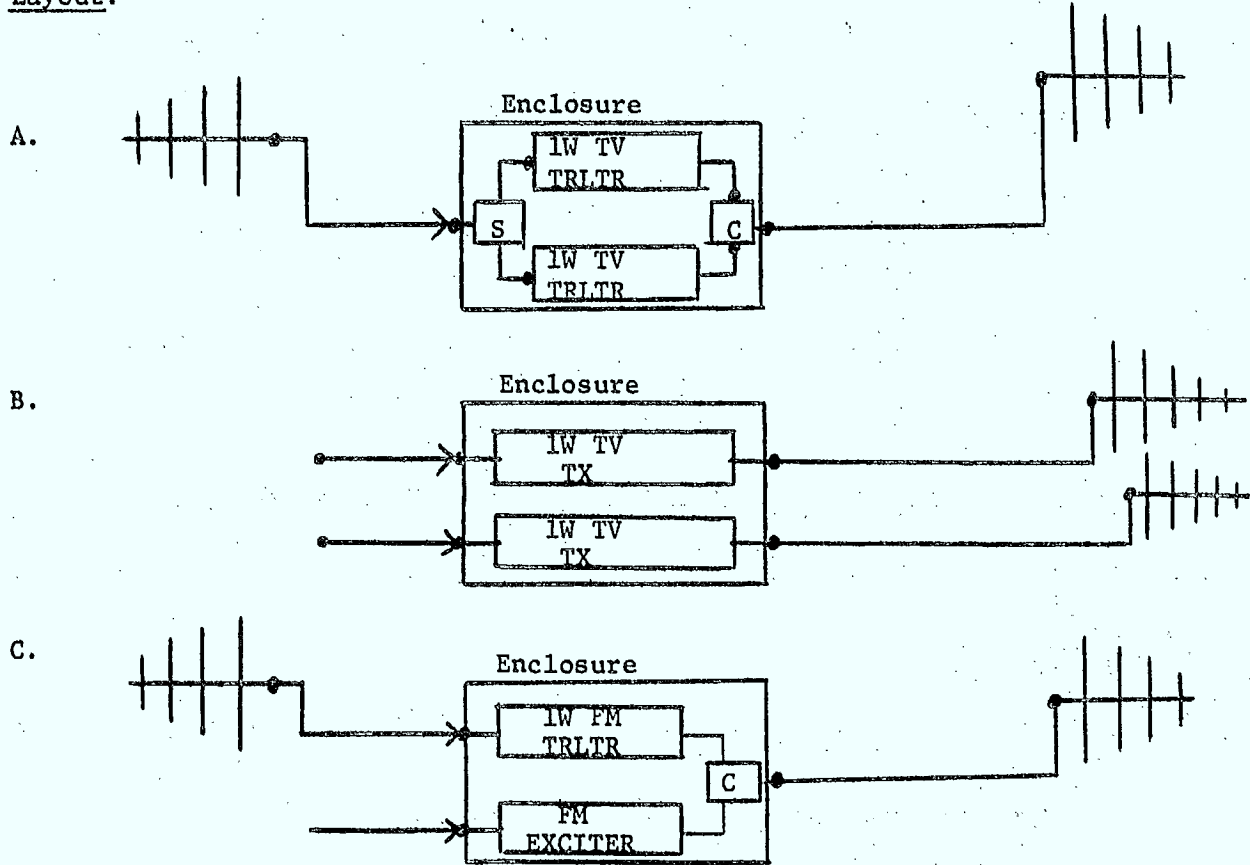
2.1.1 Basic model No.1 - Pole mounted model for 2 miles coverage

4 Ch. TV
2 FM

1. Assumptions:

- (1) 100' high
- (2) H-VHF
- (3) Grade "B" Coverage
- (4) $\Delta h = 10$ or 50 m

2. Layout:



DC:

TOTAL

Low Cost Model : \$37,365

Medium Cost Model : \$64,830

3. Equipment breakdown

A)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Antenna RX Lindsay 9R2 Lindsay LP234 deicing	310.	100.	460.
- Preamp Jerrold 4000 EMCEE		150. 450.	
- Cable 100' of Andrew LDF4-75	150.		150.
- Environmental enclosure	2,850.		2,850.
- Signal Splitter - Jerrold 1592C Acrodyne HC Series	5.		350.
- RF input filter Lindsay BPF-75RM FM, VHF		115. 215.	
- Translator DBC TS-001 1W	3,200.		
DBC TS-001 1W	3,100.		
EMCEE 1W Translator VHF			7,000.
EMCEE 1W Translator UHF		8,800.	7,000.
- Combiner Acrodyne HC Series* DBC 609-023	350.		500.
- Cable 100' of Andrew LDF5-50	350.		350.
- Antenna TX Lindsay 10LP7 Sinclair 215-TV deicing	360.	100.	650.
	<hr/>		<hr/>
SUB-TOTAL:	10,575.		19,310.
Miscellaneous Accessories	500.		1,500.
TOTAL:	<u>11,075.</u>		<u>20,810.</u>

* No adjacent channels.

B)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Environmental Enclosure	2,850.		2,850.
- TV transmitter 1W			
DBC TM-001	5,300.		
DBC TM-001	5,300.		
EMCEE 1W VHF			11,500.
EMCEE 1W UHF		13,500.	11,500.
- Cable 100' of Andrew LDF5-50	350.		350.
- Cable 100' of Andrew LDF5-50	350.		350.
- Antenna TX Lindsay 10LP7	360.		
Lindsay 10LP7	360.		
deicing		100.	
Sinclair 215 TV			650.
Sinclair 215 TV			650.
SUB-TOTAL:	<u>14,870.</u>		<u>27,850.</u>
Miscellaneous			
Accessories	500.		1,500.
TOTAL:	<u>15,370.</u>		<u>29,350.</u>

DCE

C)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Environmental Enclosure	2,850.		2,850.
- Antenna RX Lindsay 9 RY deicing Lindsay LPFM	310.	100.	460.
- Cable Andrew LDF 4-75 - 100 '	150.		150.
- RF input filter Lindsay BPF-75 RM		215.	
- FM Translator Crowder TT-FMC	2,700.		
- or FM Receiver McMartin TBM-1-5B - FM TX Sintronics 10W Stereo SCA		1,700. 1,000.	4,500.
- FM TX Sintronics 10W	3,400.		
- FM TX QEI 10W Stereo SCA	1,700. 1,000.		4,000.
- Audio limiter - Thomson-CSF		2,000.	
- Combiner Acrodyne HC Series* DBC 609-023	350.		500.
- Cable 100' of Andrew LDF5-50	350.		350.
- Antenna Lindsay 9RY deicing Lindsay 10LPFM	310.	100.	360.
	<u>SUB-TOTAL:</u>		<u>13,170.</u>
	Miscellaneous Accessories	500.	1,500.
	<u>TOTAL:</u>		<u>14,670.</u>

* Frequencies should not be too close.

2.1.2 Basic model No.1 - Pole mounted model for 4 miles coverage

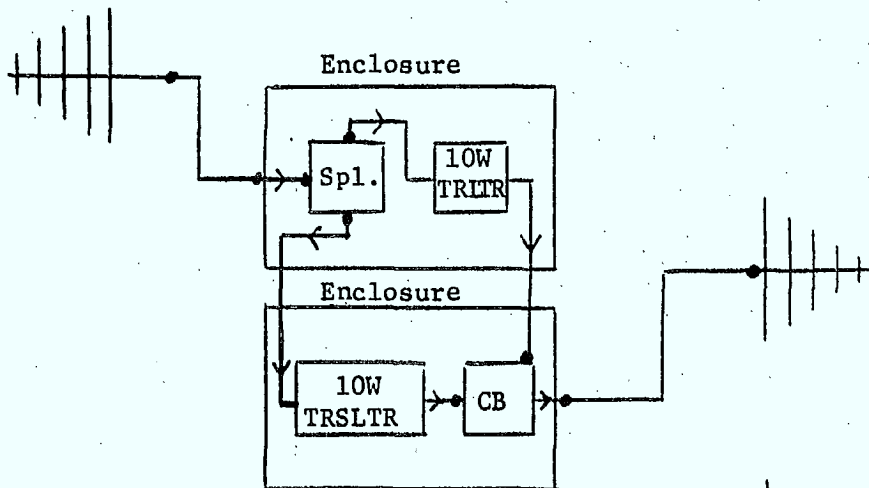
4 Ch. TV
2 FM

1. Assumptions:

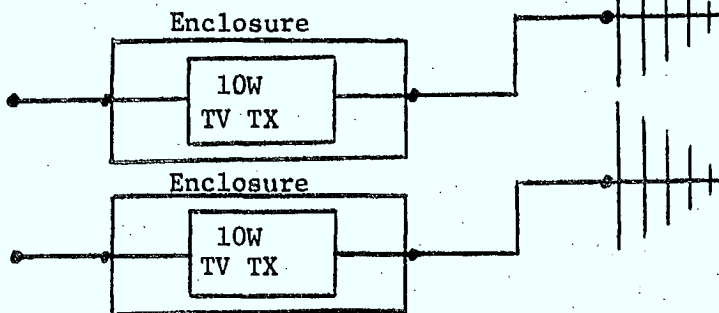
- (1) 100' high
- (2) H-VHF
- (3) Grade "B" Coverage
- (4) $\Delta h = 10$ or 50 m

2. Layout:

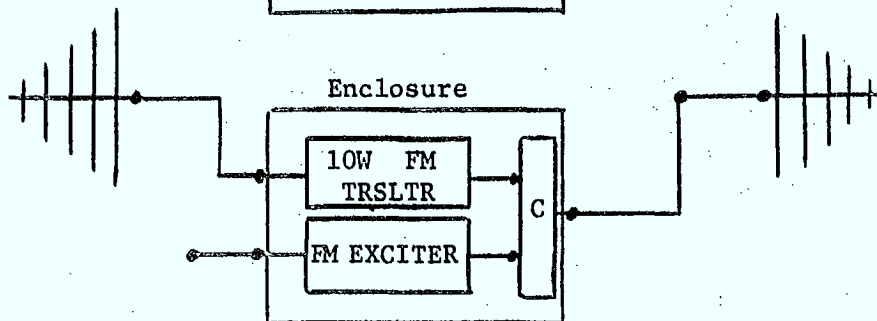
A.



B.



C.



TOTAL:

Low Cost Model : \$50,065.

Medium Cost Model : \$78,530.

DC:

3. Equipment breakdown

A)	<u>PRICE</u>		
	<u>Low Cost</u>	<u>Variations</u>	<u>Medium Cost</u>
- Antenna RX Lindsay 9R2 Lindsay LP234 deicing	310.	100.	460.
- Preamp Jerrold 4000 Series EMCEE		150. 450.	
- Cable - 100' of Andrew LDF4-75	150.		150.
- Environmental Enclosure Environmental Enclosure	2,850. 2,850.		2,850. 2,850.
- Signal Splitter Jerrold 1592C Acrodyne HC Series	5.		350.
- RF input filter Lindsay BPF-75 RM FM, UHF		115. 215.	
- Translator DBC 10W TS-010 DBC 10W TS-010 DBC UHF 10W EMCEE 10W VHF EMCEE 10W VHF Acrodyne 20W UHF	4,200. 4,200.	14,000.	7,800. 7,800.
- Combiner Acrodyne HC Series* DBC 609-023	350.	20,000.	500.
- Cable 100' of Andrew	350.		350.
- Antenna TX Lindsay 10LP7 Sinclair 215-TV deicing	360.	100.	650.
	<u>SUB-TOTAL:</u>		<u>23,760.</u>
	Miscellaneous Accessories	500.	1,500.
	<u>TOTAL:</u>	<u>16,155.</u>	<u>25,260.</u>

* No adjacent channels.

B)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Environmental Enclosure	2,850.		2,850.
Environmental Enclosure	2,850.		2,850.
- TV TX DBC TM-010	7,300.		
DBC TM-010	7,300.		
10W EMCEE VHF			14,700.
10W EMCEE VHF			14,700.
20W Acrodyne UHF		23,500.	
- Cable 100' of Andrew LDF5-50	350.		350.
100' of Andrew LDF5-50	350.		350.
- Antenna TX Lindsay 10LP7	360.		
Lindsay 10LP7	360.		
deicing		100.	
Sinclair 215-TV			650.
Sinclair 215-TV			650.
	<hr/>		<hr/>
SUB-TOTAL:	21,720.		37,100.
Miscellaneous Accessories	500.		1,500.
TOTAL:	<u>22,220.</u>		<u>28,600.</u>

DC:

C)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Environmental Enclosure	2,850.		2,850.
- Antenna RX Lindsay 9RY deicing Lindsay LPFM	310.	100.	460.
- Cable Andrew LDF4-75 100'	150.		150.
- RF input Filter Lindsay BPF-75RM		215.	
- FM Translator Crowder TT-FM 10W or FM RX McMartin TBM-1005B	3,470.		
+ FM TX Sintronics 10W Stereo SCA		1,700.	4,500.
- FM TX Sintronics 10W 10W FM TX QEI Stereo SCA	3,400	1,000.	
- Audio limiter - Thomson-CSF		1,700.	4,000.
- Combiner Acrodyne HC Series * DBC 609-023	350.	1,000. 2,000.	
- Cable Andrew LDF5-50 - 100'	350.		350.
- Antenna Lindsay 9RY deicing Lindsay 10LPFM	310.	100.	
			360.
	<u>SUB-TOTAL:</u>		<u>13,170.</u>
	Miscellaneous Accessories		
	500.		1,500.
	<u>TOTAL:</u>		<u>14,670.</u>

* Frequencies should not be too close.

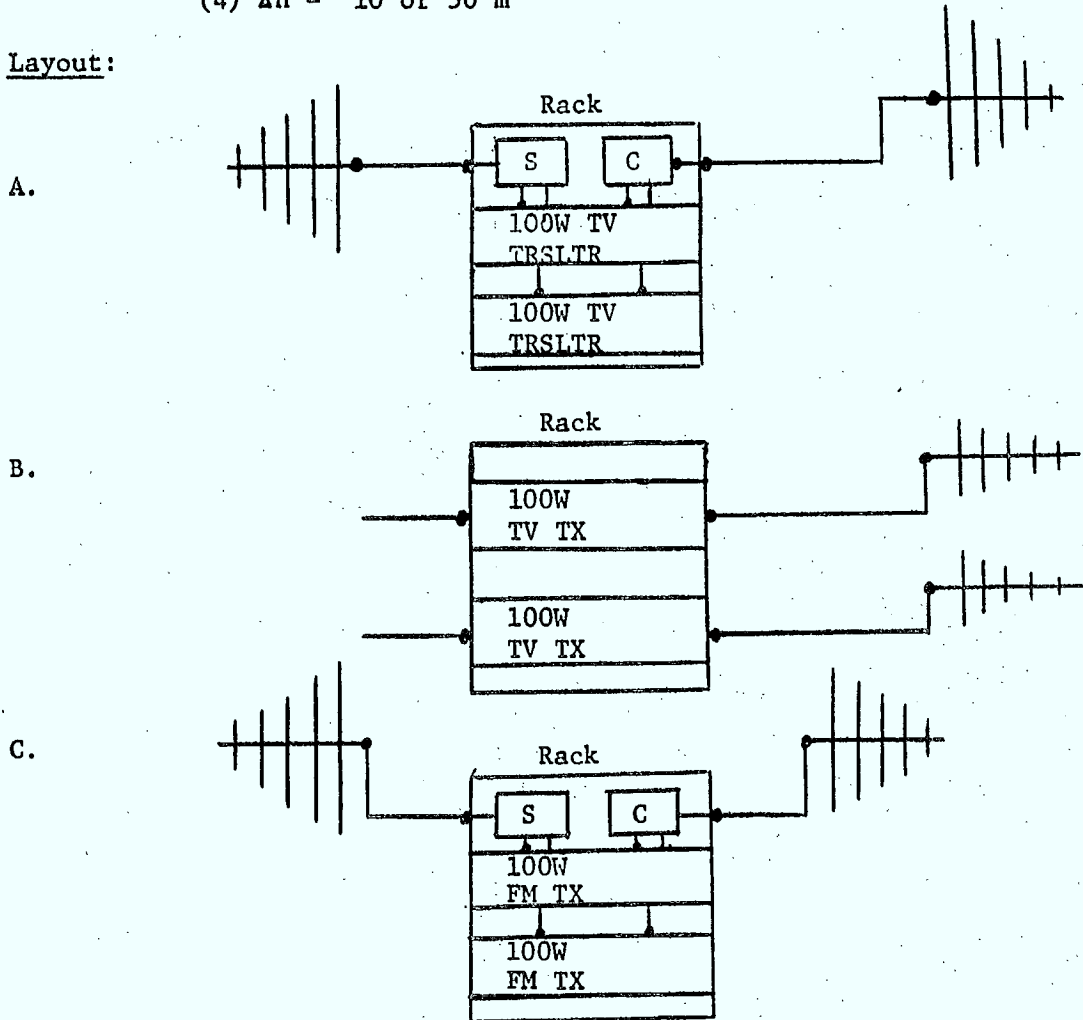
2.1.3 Basic model No. 2 - Standard shelter model for 8 miles coverage

4 Ch. TV
2 FM

1. Assumptions:

- (1) 150' high
- (2) H-VHF
- (3) Grade "B" Coverage
- (4) $\Delta h = 10$ or 50 m

2. Layout:



TOTAL:

Low Cost Model : \$121,825.

Medium Cost Model : \$132,670.

3. Equipment breakdown

A)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Antenna RX Lindsay 9R2 Lindsay LP234 deicing	310.	100.	460.
- Preamp Jerrold 4000 Series EMCEE		150. 450.	
- Cable 200' of Andrew LDF4-75	300.		300.
- Rack and accessories	400.		400.
- Signal Splitter Jerrold 1592C Acrodyne HC Series	5.		350.
- RF input filter Lindsay BPF-75RM FM, UHF		115. 215.	
- Translator EMCEE 100W VHF	21,000.		
EMCEE 100W VHF	21,000.		
Acrodyne 200W UHF		42,000.	
Acrodyne 100W VHF			22,000.
Combiner Kathrein K 62 Series *	800.		800.
- Cable 200' of Andrew LDF5-50	700.		700.
- Antenna TX Sinclair 206 TV	350.		
Sinclair 215 TV			650.
deicing		100.	
	<u>SUB-TOTAL</u>		<u>47,660.</u>
	Miscellaneous Accessories	500.	1,500.
	<u>TOTAL:</u>	<u>45,365.</u>	<u>49,160.</u>

* Price could vary according to the frequency separation. No adjacent channels.

B)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Rack and accessories	400.		400.
- TV TX EMCEE 100W VHF	26,000.		
EMCEE 100W VHF	26,000.		
Acrodyne 200W UHF		65,000.	
Acrodyne 100W VHF			28,500.
Acrodyne 100W VHF			28,500.
- Cable 200' of Andrew LDF5-50	700.		700.
200' of Andrew LDF5-50	700.		700.
- Antenna TX Sinclair 206-TV	350.		
Sinclair 206-TV	350.		
Sinclair 215-TV			650.
Sinclair 215-TV			650.
deicing		100.	
SUB-TOTAL:	<u>54,500.</u>		<u>60,100.</u>
Miscellaneous Accessories	500.		1,500.
TOTAL:	<u>55,000.</u>		<u>61,600.</u>

C)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Rack & accessories	400.		400.
- Antenna RX Lindsay 9RY deicing Lindsay LPPM	310.	100.	460.
- Cable Andrew LDF4-75, 200'	300.		300.
- RF input filter - Lindsay BPF-75RM		215.	
- FM RX McMartin + CSI 100W TX CSI 100W TX	9,550. 8,550.		9,550. 8,550.
- Stereo SCA		1,700. 1,000. 2,000.	
- Audio limiter - Thomson-CSF			
- Combiner Kathrein K 62 Series *	800.		800.
- Cable 200' of Andrew LDF5-50	700.		700.
- Antenna TX Sinclair 206 FM 215 FM deicing	350.		650.
		100.	
	<u>20,960.</u>		<u>21,410.</u>
	Miscellaneous Accessories	500.	1,500.
	<u>TOTAL:</u>	<u>21,480.</u>	<u>21,910.</u>

* Price could vary according to the frequency separation. Frequencies should not be too close.

2.1.4 Basic model No.2 - Standard shelter model for 8 miles coverage

4 ch TV
2 FM

Assumptions:

- (1) 250'
- (2) H-VHF
- (3) Grade "B" Coverage
- (4) $\Delta h = 100$ m

Costs as in the Standard Shelter Model, Section 2.1.3

Plus:

- A) \$ 500. additional for cable length
- B) 700. additional for cable length
- C) 500. additional for cable length
- 1,700.

Low Cost Model : \$123,525.

Medium Cost Model : \$134,370.

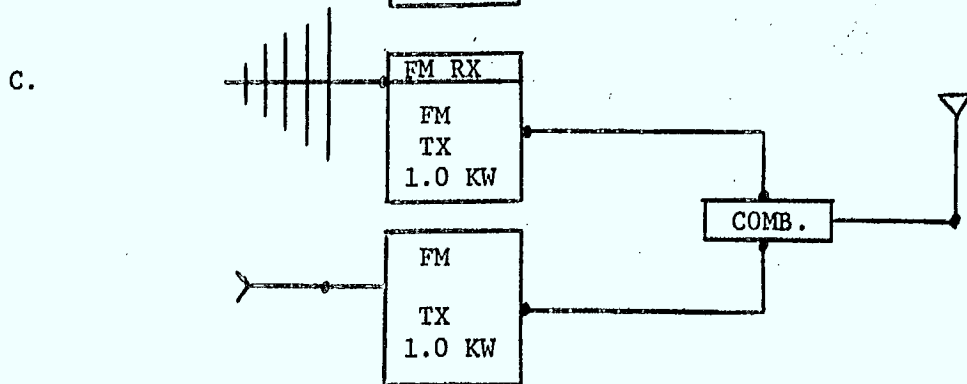
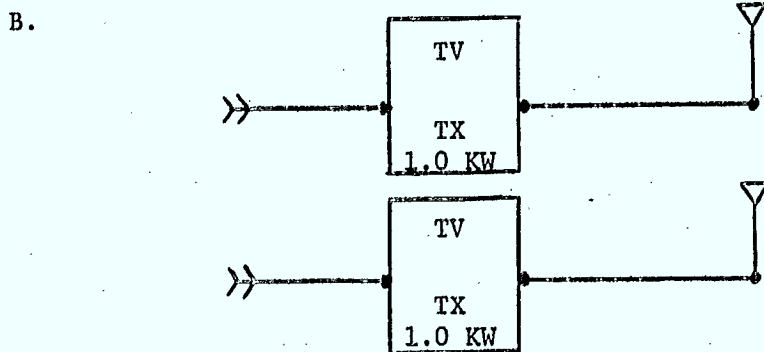
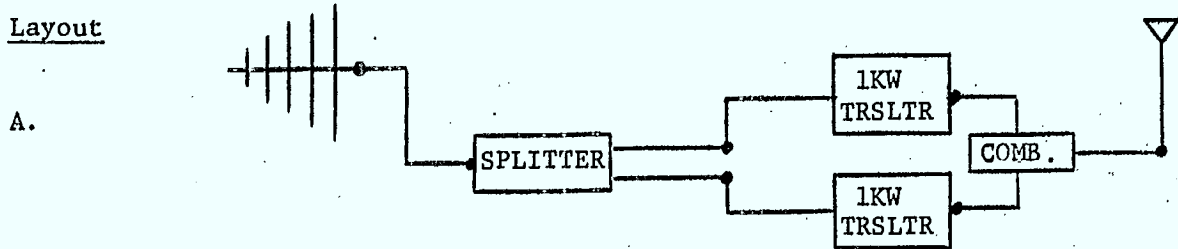
2.1.5 Basic model No. 2 - Standard shelter for 14 miles coverage

4 ch. TV
2 FM

1. Assumptions:

- (1) 150'
- (2) H-VHF
- (3) Grade "B" Coverage
- (4) $\Delta h = 10$ or 50 m

2. Layout



TOTAL:

Low Cost Model : \$339,225.
Medium Cost Model : \$449,870.



Medium power transmitting antenna

3. Equipment breakdown

	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
A)			
- Antenna RX Lindsay 9R2 Lindsay LP 234 deicing	310.	100.	460.
- Preamp Jerrold 4000 Series EMCEE		150. 400.	
- Cable -200' of Andrew LDF4-75	300.		300.
- Signal Splitter Jerrold 1592C Acrodyne HC Series	5.		350.
- RF input filter Lindsay BPF-75 RM FM, UHF		115. 215.	
- Translator EMCEE 1000W VHF EMCEE 1000W VHF EMCEE 1000W UHF Acrodyne 100W VHF Acrodyne 100W VHF	70,000. 70,000.	76,000.	84,000. 84,000.
- Combiner Sinclair Shively *	3,000.		4,000.
- Cable - 200' of Andrew	1,500.		1,500.
- Antenna TX Bogner B2VP-H-VHF deicing Bogner B2VP-L-VHF Bogner B4V-UHF	2,500.	500. 5,000. 5,000.	2,500.
	<u>SUB-TOTAL:</u>		<u>177,110.</u>
	Miscellaneous		2,500.
	<u>TOTAL:</u>		<u>179,610.</u>

* Price of the combiner highly dependent upon the frequency separation.
No adjacent channels.

B)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- TV TX EMCEE 1000W H-VHF	70,000.		
- TV TX EMCEE 1000W H-VHF	70,000.		
EMCEE 1000W L-VHF		80,000.	
EMCEE 1000W UHF		76,000.	
Acrodyne 1000W VHF			107,000.
Acrodyne 1000W VHF			107,000.
- Cable 200' of Andrew LDF7-50	1,500.		1,500.
200' of Andrew LDF7-50	1,500.		1,500.
- Antenna TX Bogner B2VP-H-VHF	2,500.		2,500.
Bogner B2VP-H-VHF	2,500.		2,500.
deicing		500.	
Bogner B2VP-L-VHF		5,000.	
Bogner UHF		5,000.	
	<u>SUB-TOTAL:</u>		<u>222,000.</u>
	Miscellaneous Accessories	1,500.	2,500.
	<u>TOTAL:</u>	<u>149,500.</u>	<u>224,500.</u>

DCI:

C.	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Antenna RX Lindsay 9RY deicing Lindsay LPFM	310.	100.	460.
- Cable Andrew LDF4-75 - 200'	300.		300.
- Preamp Jerrold		150.	
- RF input filter Lindsay BPF-75 RM		215.	
- FM RX -McMartin, Sintronics 1000W FM TX or CSI FM TX 1000W	15,000.		16,500.
- Audio limiter - Thomson-CSF		2,000.	
- FM TX -Sintronics 1000W Stereo	14,000.	1,700.	
- FM TX -CSI 1000W SCA		1,000.	15,500.
- Combiner Sinclair Shively*	3,000.		4,000.
- Cable 200' of Andrew LDF7-50	1,500.		1,500.
- Antenna TX Bogner B2VP-FM deicing	5,000.		5,000.
		1,000.	
	<u>39,110.</u>		<u>43,260.</u>
	Miscellaneous Accessories		
	1,500.		2,500.
	<u>TOTAL:</u>		<u>45,760.</u>

* Price of the combiner highly dependent upon the frequency separation.
Frequencies should not be too close.

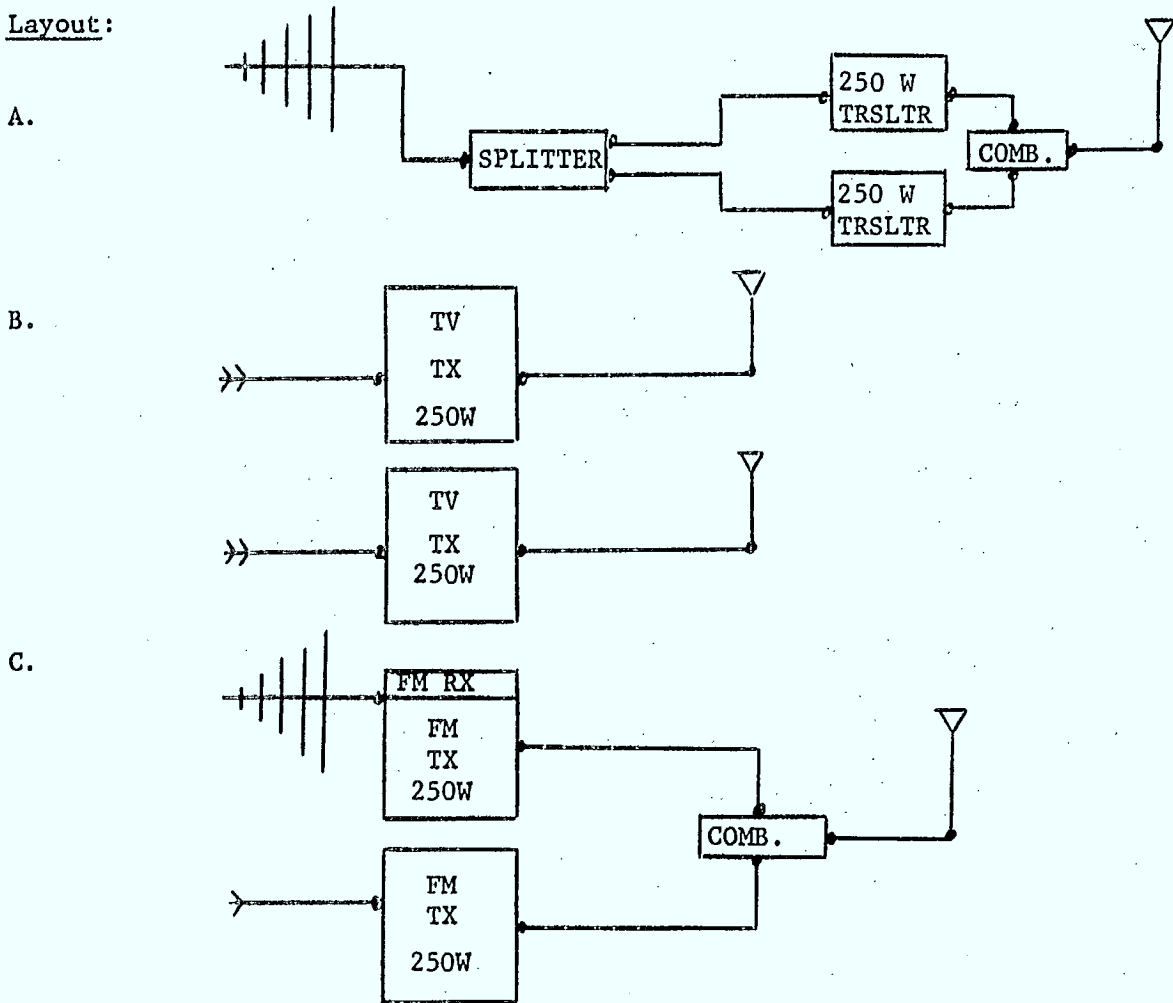
2.1.6 Basic model No.2 - Standard shelter for 14 miles coverage

4 ch. TV
2 FM

1. Assumptions:

- (1) 250'
- (2) H-VHF
- (3) Grade "B" Coverage
- (4) $\Delta h = 10$ or 50 m

2. Layout:



TOTAL:

Low Cost Model : \$187,425.

Medium Cost Model : \$193,070.



Medium power transmitting antenna

3. EQUIPMENT BREAKDOWN

A)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Antenna RX Lindsay 9R2 Lindsay LP234 deicing	310.	100.	460.
- Preamp Jerrold 4000 Series EMCEE		150. 400.	
- Cable 300' of Andrew LDF4-75	450.		450.
- Signal Splitter Jerrold 1592C Acrodyne HC-Series	5.		350.
- RF input filter Lindsay BPF-75 RM FM, VHF		115. 215.	
- Translator Acrodyne 250W VHF	29,000.		29,000.
Acrodyne 250W VHF	29,000.		29,000.
Acrodyne 500W UHF		56,300.	
- Combiner Sinclair Shively *	3,000.		4,000.
- Cable 300' of Andrew LDF5-50	1,100.		1,100.
- Antenna TX Bogner B4VP H-VHF L-VHF UHF deicing	5,000.	10,000. 5,000. 1,000.	5,000.
	<u>SUB-TOTAL:</u>		<u>69,360.</u>
	Miscellaneous Accessories	1,500.	2,500.
	<u>TOTAL:</u>	<u>69,365.</u>	<u>71,860.</u>

* Price of the combiner highly dependent upon the frequency separation.
No adjacent channels.

B)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- TV TX Acrodyne 250W VHF	36,500.		36,500.
Acrodyne 250W VHF	36,500.		36,500.
Acrodyne 500W UHF		69,300.	
- Cable 300' of Andrew LDF5-50	1,100.		1,100.
300' of Andrew LDF5-50	1,100.		1,100.
- Antenna TX Bogner B4VP-H-VHF	5,000.		5,000.
B4VP-H-VHF	5,000.		5,000.
B4VP-L-VHF		10,000.	
B4VP-UHF		5,000.	
deicing		1,000.	
	<hr/>		<hr/>
SUB-TOTAL:	85,200.		85,200.
Miscellaneous Accessories	1,500.		1,500.
TOTAL:	<u>86,700.</u>		<u>87,700.</u> DGC:

C)	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Antenna RX Lindsay 9RY deicing Lindsay LPFM	310.	100.	460.
- Cable Andrew LDF4-75 300'	450.		450.
- Preamp Jerrold		150.	
- RF input filter Lindsay BPF-75 RM		215.	
- FM RX McMartin 250W CSI FM TX	12,000.		12,000.
250W CSI FM TX	11,000.		11,000.
Stereo		1,700.	
SCA		1,000.	
- Audio limiter - Thomson-CSF		2,000.	
- Combiner Sinclair Shively *	3,000.		4,000.
- Cable 300' of Andrew LDF5-50	1,100.		1,100.
- Antenna TX Kathrein K522217 Bogner B2VP-FM	2,000.		5,000.
SUB-TOTAL:	<u>29,860.</u>		<u>34,010.</u>
Miscellaneous Accessories	1,500.		2,500.
TOTAL:	<u>31,360.</u>		<u>36,510.</u>

* Price of the combiner highly dependent upon the frequency separation. Frequencies should not be too close.

2.1.7 Basic model No.2 - Standard shelter for 14 miles coverage

4 ch. TV
2 FM

Assumptions: (1) 250'
(2) H-VHF
(3) Grade "B" Coverage
(4) $\Delta h = 100$ m

Costs as in Standard Shelter Model, Section 2.1.5.

Plus: Cost for additional length of cable

A : \$ 900.
B : 1,500.
C : 900.

Low Cost Model : \$342,525.

Medium Cost Model : \$453,170.

DCB

2.1.8 Basic model No. 3 - Special shelter model

- 1 - Low Power Version: (1) 2 miles coverage approx. (based on height of 300')
 (2) 1W power for each TX
 (3) 2 racks: 4 TV, 2 FM
 (4) Costs as in Model 2.1.1 except for rack instead of enclosures.
 (5) $\Delta h = 100$ m
 (6) 3 miles for $\Delta h = 50$ m

A : \$ 8,625. / \$ 18,360.

B : 12,920. / 26,900.

C : 8,070. / 11,820.TOTAL 29,615. / 57,080.

- 2 - Medium Power Version: (1) 4 miles coverage approx. (based on height of 300')
 (2) 10W power for each TX
 (3) 2 racks: 4 TV only
 (4) Costs as in Model 2.1.2 except for racks instead of enclosures.
 (5) $\Delta h = 100$ m
 (6) 6 miles for $\Delta h = 50$ m

A : \$ 13,705 / \$ 22,810.

B : 19,770 / 36,150.

C : 8,840 / 11,820.

TOTAL 42,315 / 70,780.

2.1.9 Basic model No.4 - Existing housing model

- 1- Low Power Version: (1) 4 miles coverage approx. (based on 100' high)
 (2) 10W power for each TX
 (3) 3 racks: 4 TV, 2 FM
 (4) Costs as in Model 2.1.2 except for racks instead of enclosures.
 (5) $\Delta h = 50$ m

A : \$ 13,705. / \$ 22,810.

B : 19,770. / 36,150.

C : 9,240. / 12,220.

TOTAL 42,715. / 71,180.

- 2- Medium Power Version: (1) 8 miles coverage approx. (based on 150' high)
 (2) 100W power for each TX
 (3) 3 racks: 4 TV, 2 FM
 (4) Costs as in Model 2.1.3
 (5) $\Delta h = 50$ m

A : \$ 45,365. / \$ 49,160.

B : 55,000. / 61,600.

C : 21,460. / 21,910.

TOTAL 121,825. / 132,670.

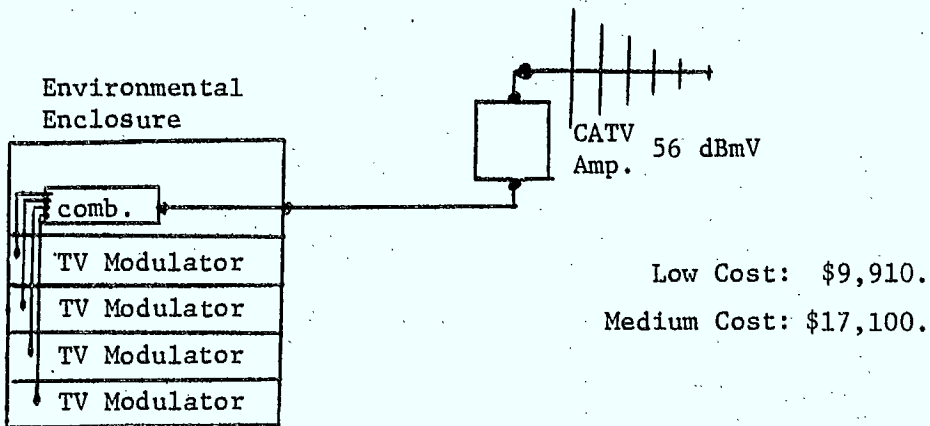
DC:

2.2 COSTS RELATED TO NON-STANDARD APPLICATIONS

2.2.1 4 TV Channels

- Assumptions: (1) Pole mounted 100' & use of an environmental enclosure
 (2) H-VHF
 (3) Direct feed
 (4) TV Modulators & CATV Amplifier

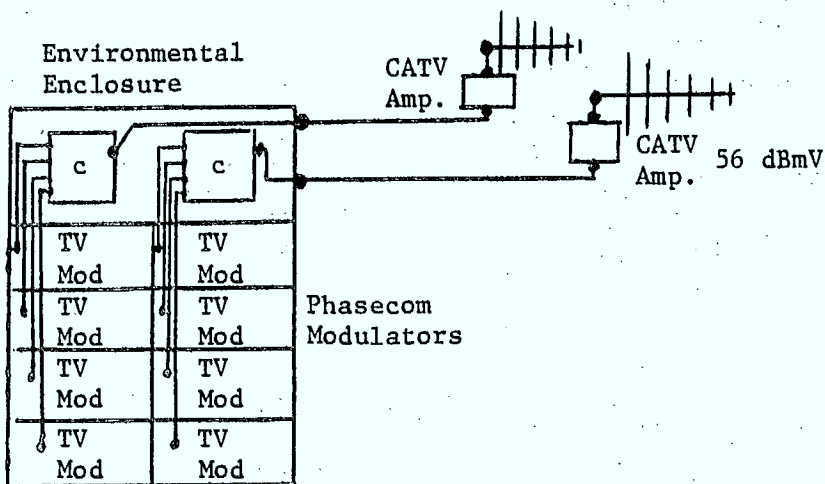
Layout



NOTE: VHF channels only. UHF frequencies could be used by connecting the TV modulator directly to the TX antenna.

2.2.2 8 TV Channels

Same as above, except for the TV modulators, which have to be Phasecom Models to use up only one enclosure; otherwise, 2 enclosures have to be used.



NOTE: VHF Channels only.

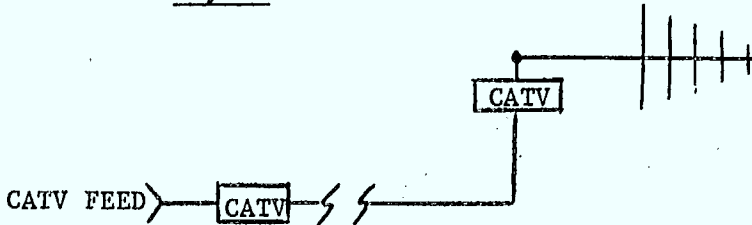
- 2 enclosures: \$ 19,820.
- 1 enclosure : \$ 23,370.

DC:

EQUIPMENT BREAKDOWN <u>4</u> ch. TV	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Environmental Enclosure	2,850.		2,850.
- TV Modulator - Triple Crown TSP-M	1,000.		
- Triple Crown TSP-M	1,000.		
- Triple Crown TSP-M	1,000.		
- Triple Crown TSP-M	1,000.		
TV Modulator - Jerrold Commander II (A)			4x2,600.-10,400
- 4-way Combiner DBC 609-023-12	550.		550.
- Cable - 100' of Andrew FHJ4-75	150.		150.
- CATV Amplifier Jerrold Starline 20/300A Century III 3101 H/220	1,500.	1,400.	1,500.
- Antenna TX, Lindsay 10LP7 Sinclair 215-TV deicing	360.		650.
		100.	
SUB-TOTAL:	<u>9,410.</u>		<u>16,100.</u>
Miscellaneous Accessories	500.		1,000.
TOTAL:	<u>9,910.</u>		<u>17,100.</u>

8 ch. TV	<u>PRICE</u>		
	Low Cost	Variations	Medium Cost
- Environmental Enclosure (Quantity 2)	2,850. 2,850.		2,850. (1)
- T.V. Modulator Triple Crown TSP-M (Quantity 8)	8,000.		Phasecom (8) 14,400.
- 4 way Combiner DBC 609-023-12 (Quantity 2)	1,100.		1,100.
- Cable 100' of Andrew FH24-75 (Quantity 2)	300.		300.
- CATV Amplifier Century III 3101 H/220 (Quantity 2)	3,000.		3,000.
- Antenna Lindsay 10LP7 (Quantity 2) deicing	720.		720.
		200.	
SUB-TOTAL:	<u>18,820.</u>		<u>22,370.</u>
Miscellaneous Accessories	1,000.		1,000.
TOTAL:	<u>19,820.</u>		<u>23,370.</u>

DCE

2.2.3 Broadcasting of Direct CATV FeedLayoutAssumptions:

- (1) Pole mounted 100'
- (2) VHF only
- (3) As CATV feed for number of channels.

Costs:

2 CATV Amplifiers @ 1,500:	\$3,000.
100' of Cable Andrew FHJ4-75	150.
Antenna Lindsay 10LP7	360.
Miscellaneous, accessories	500.

TOTAL: \$4,010.

2.2.4 USE OF A FM SUBCARRIER FOR TRANSMISSIONCosts involved to establish the link: (1 audio channel)

1) SCA Generator (67 KHZ) QEI	\$1,000.
2) McMartin TBM-1005C, with SCA Module	1,500.
3) Miscellaneous equipment	500.
TOTAL:	<u>\$3,000.</u> per audio channel.

For 2 audio channels on the same carrier:

1) SCA Generator (67 & 41 KHZ) QEI, quantity 2	\$2,000.
2) McMartin TBM-1005C, with 2 SCA modules	2,000.
3) Miscellaneous equipment	500.
TOTAL:	<u>\$4,500.</u>

2.3 AM Transmission

1. (1) Based on the use of an environmental enclosure
- (2) 50W power
- (3) Low efficiency antenna (wire in between two wooden poles)
- (4) Coverage of approximately 5-10 miles during the day, 1 mile at night
- (5) Direct feed

Costs:

Environmental enclosure	\$2,850.
50W CSI T-.05A TX	3,000.
50' of Andrew LDF4-50, plus connectors	150.
Transmission wire, accessories	500.

SUB-TOTAL:	<u>6,500.</u>
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Miscellaneous Equipment	500.
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TOTAL:	<u>7,000.</u>
--------	---------------

2. (1) Based on the use of standard shelter, existing housing or special shelter
- (2) Low efficiency antenna (wire in between two wooden poles)
- (3) 250W power
- (4) Coverage of approximately 15-20 miles during the day, 2-3 miles at night
- (5) Direct feed

Costs:

250W CSI T-1-A TX	13,000.
100' of Andrew LDF4-50, plus connectors	200.
Transmission wire, accessories	800.

SUB-TOTAL:	<u>14,000.</u>
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Miscellaneous Equipment	1,000.
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TOTAL:	<u>15,000.</u>
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2.4 Second audio channel for TV

Equipment is not readily available on the market, but equipment similar to above equipment, slightly modified, could be used.

Modified:

1) SCA Generator (31.5 KHZ) QEI	\$1,500.
2) McMartin TBM-1005C, with SCA module, <u>modified</u>	2,000.
3) Miscellaneous equipment	500.
TOTAL:	<u>\$4,000.</u>

3. ELEMENTS OF MAINTENANCE COSTS

This section gives the costs of spare parts for the Acrodyne Equipment. It is based on a Telecon between G. Jolivet and Bob Norton of Applied Electronics, in Toronto.

1) 10W Translator and Transmitter

There is no tube used at this power level.

For the translator, the complete Kit of spare parts is \$450.

For the transmitter, the complete Kit of spare parts is \$970.

2) 100W Translator and Transmitter

One tube is used at this power level.

The cost of the tube is \$350. for VHF and \$1,250 for UHF.

The tube is rated for 8000-10000 hours, 24 hours a day; the tube life can therefore be expected to be 18 months approximately.

For the translator, the complete kit of spare parts is \$750. for VHF and \$1,600. for UHF, including one tube.

For the transmitter, the complete kit of spare parts is \$1,200 for VHF and \$2,050. for UHF.

3) 1.0KW Translator and Transmitter

Two tubes are used at this power level.

The costs of the tubes are $\$350 + \$2,350 = \$2,700$ for VHF, and $1,250 + \$2,550 = \$3,800$. for UHF.

The complete kit of spare parts for the translator is \$3,650. for VHF and \$4,650. for UHF.

For the transmitter, the complete kit of spare parts is \$4,100. for VHF and \$5,100. for UHF.

4) Maintenance of the CATV amplifier

The CATV amplifiers are reliable components, for which the Mean Time between Failure is relatively long.

It is recommended to check the equipment twice a year. The equipment is of modular construction, and could be serviced easily by taking out the faulty module, and replacing it by a new one. There is generally a one year warranty on the active section of the equipment, and three months on the passive section.

3. ELEMENTS OF MAINTENANCE COSTS (Cont'd)

4) Maintenance of the CATV amplifier (Cont'd)

The equipment could be repaired at a labour cost of \$25. an hour, plus the price of the parts and transportation. Diagrams and parts are also available for service by an experienced technician.

4. STANDARD RECEIVING SYSTEM

Items and Prices taken from the 1979 Radio Shack Catalog:

1) "Gold Spot" TV tower 30" tower, with all accessories (installation not included)	\$100.00
2) "Color Supreme II", Archer antenna	90.00
3) Preamp (16 dB gain approximately)	55.00
4) Cable - Foam Coaxial RG-59/U 50' @ \$0.13/ft.	6.50
5) Splitter, 3 way	4.50
6) Miscellaneous, accessories and expenses	22.00

SUB-TOTAL	\$278.00
Tax (8%)	22.00
TOTAL:	<u>\$300.00</u>

(installation not included) TOTAL: \$300.00

Rotor (optional) - \$100.00
(including cable and accessories)

/ND

D/C:

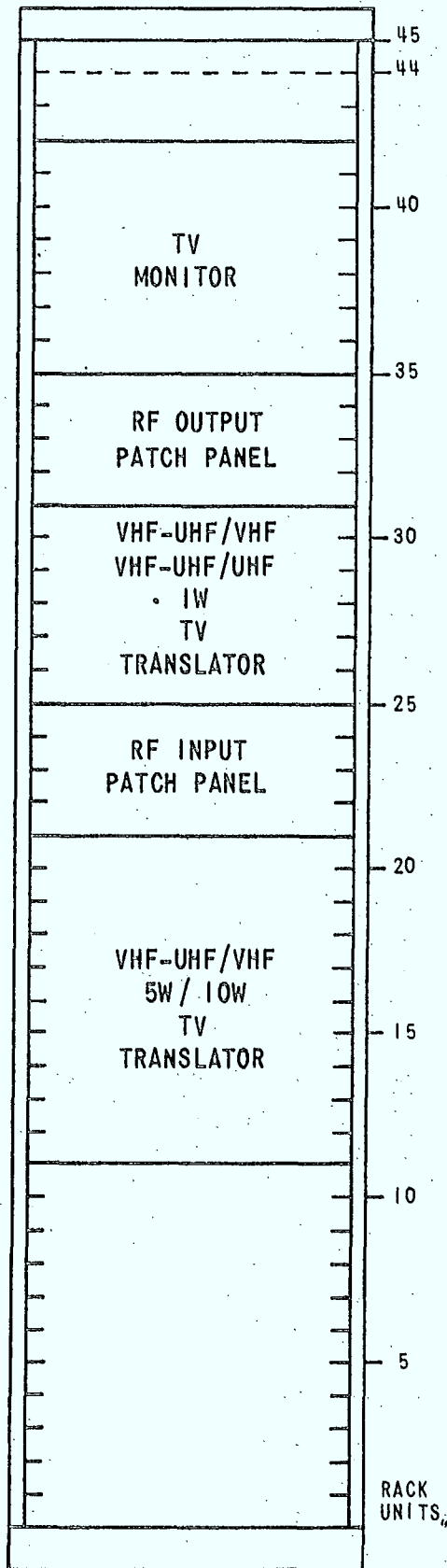
FIGURES

Figure 1 - Equipment Rack Layout No.1


Figure 2 - Equipment Rack Layout No.2

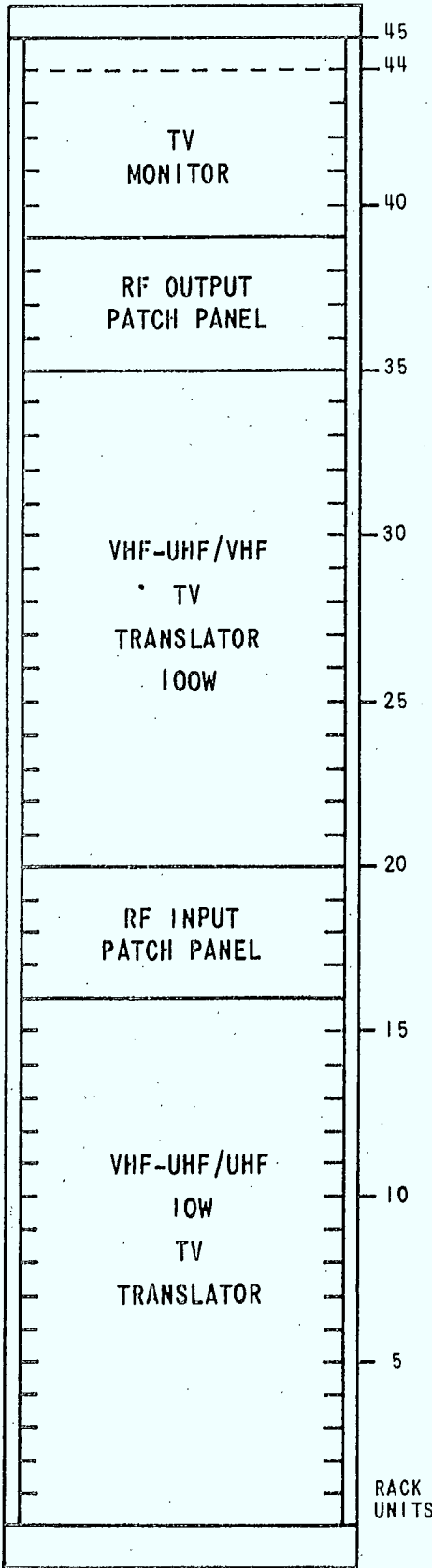
Figure 3 - Equipment Rack Layout No.3

Figure 4 - Equipment Rack Layout No.4



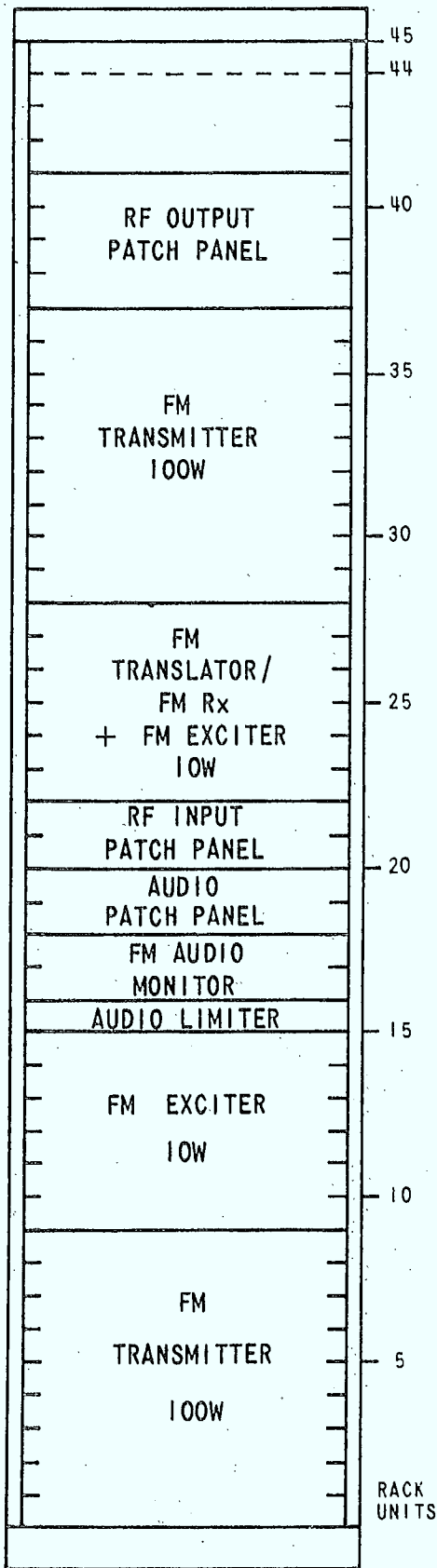
3000-11/0 FORMAT A

CLIENT DEPARTMENT OF COMMUNICATIONS		FAIT MADE R. FRENETTE		VERIFIE CHKO G. JOLIVET		DATE 1-02-79	
PROJ MULTICHANNEL TV REBROADCAST STATIONS		APPR F. DI GIANDOMENICO		ECH SCALE		DATE REV 6-07-79	
	FIG. 1 EQUIPMENT RACK LAYOUT No. 1	CONTR 5265	SUBDIV 0155	ELEMENT 47 DD		NO 01	REF 01



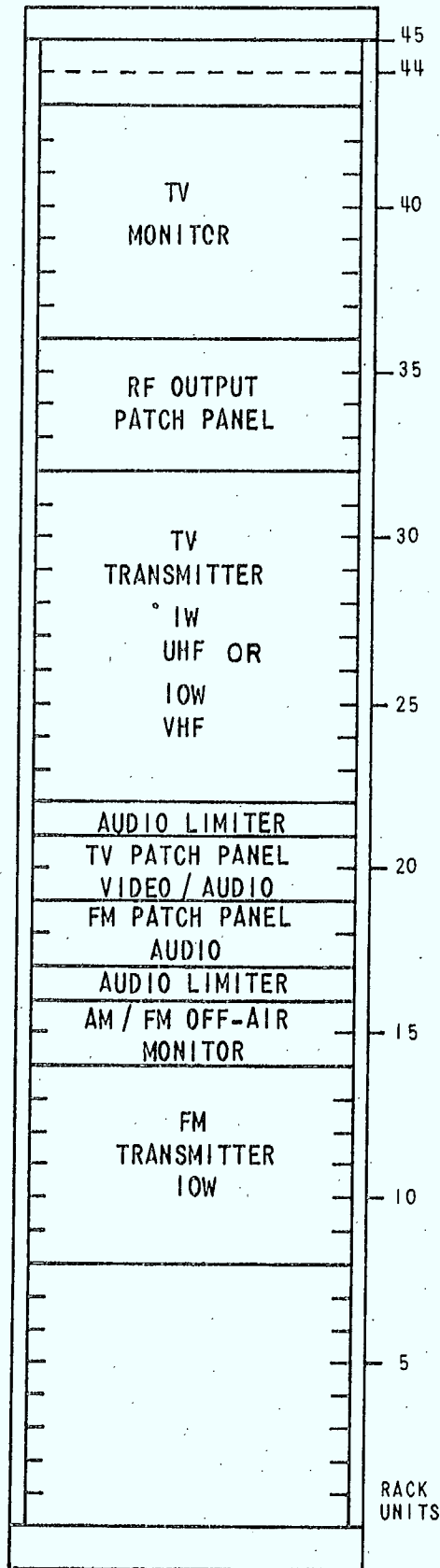
3-1110 FORMAT A

CLIENT: DEPARTMENT OF COMMUNICATIONS		FAIT MADE: R. FRENETTE	VERIFIE (CHK): G. JOLIVET	DATE: 1-02-79
PROJ: MULTICHANNEL TV REBROADCAST STATIONS		APPR: F. DI GIANDOMENICO	ECH. SCALE:	DATE-REV: 6-07-79
	FIG. 2 EQUIPMENT RACK LAYOUT No. 2	CONTR: 5265	SUBDIV: 0155	ELEMENT: 47 DD




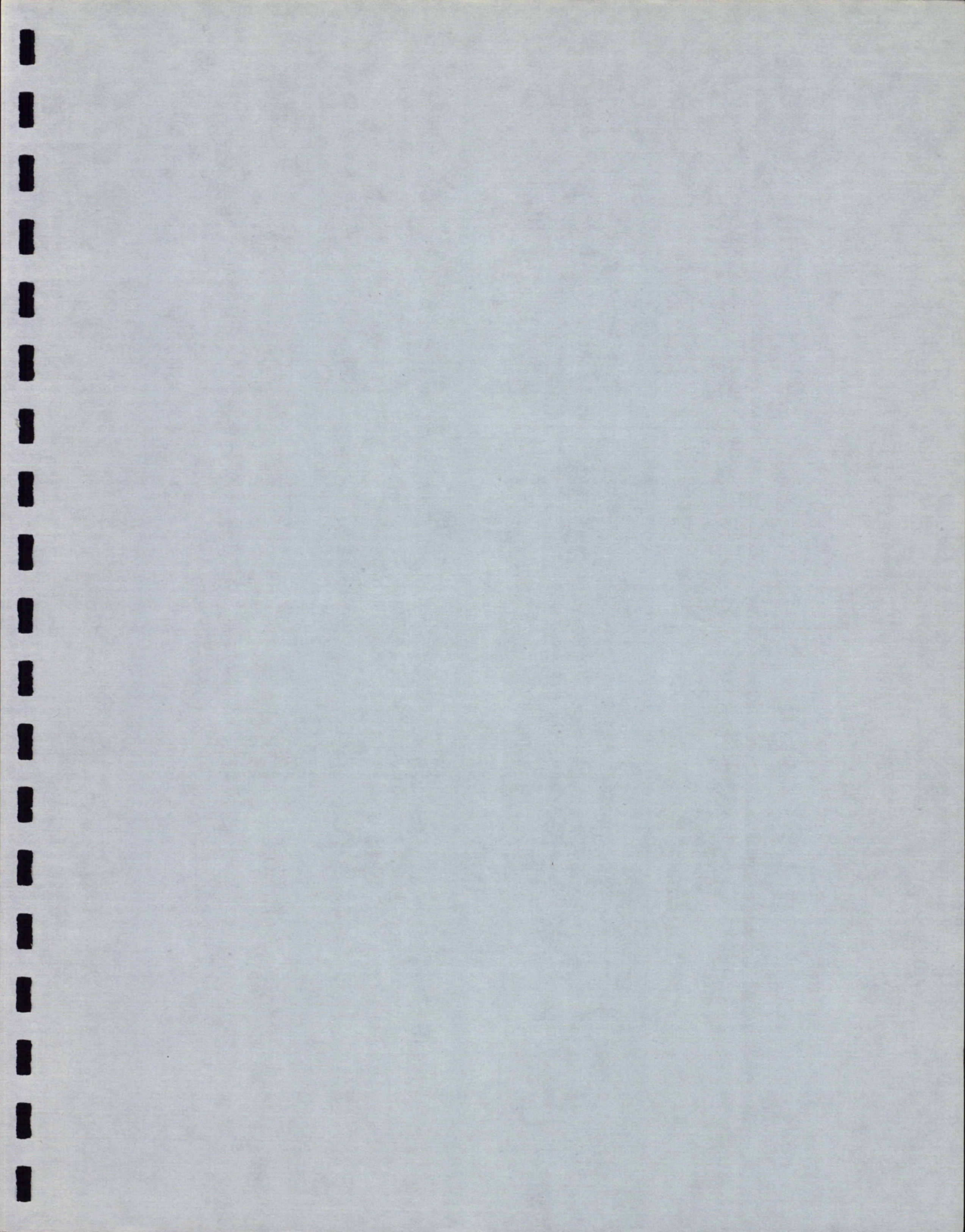
FORM 11/73 FORMAT A

CLIENT DEPARTMENT OF COMMUNICATIONS		FACT MADE R. FRENETTE	DESIGNED BY G. JOLIVET	DATE 1-02-79
PROJ MULTICHANNEL TV REBROADCAST STATIONS		APPR F. DI GIANDOMENICO	DATE 6-07-79	
	FIG. 3 EQUIPMENT RACK LAYOUT No. 3	CONTR 5265	LEVEL 0155	DATE 03 101



4400-11/0 FORMAT A

CLIENT DEPARTMENT OF COMMUNICATIONS		DESIGNED BY R. FRENETTE		CHECKED BY G. JOLIVET		DATE 1-02-79	
PROJ MULTICHANNEL TV REBROADCAST STATIONS		APPR F. DI GIANDOMENICO		FORM SCALE		DATE 6-07-79	
 FIG. 4 EQUIPMENT RACK LAYOUT No. 4	CONTR 5265	SUBDIV 0155	ELEMENT 47 DD		REV 04	APP 01	

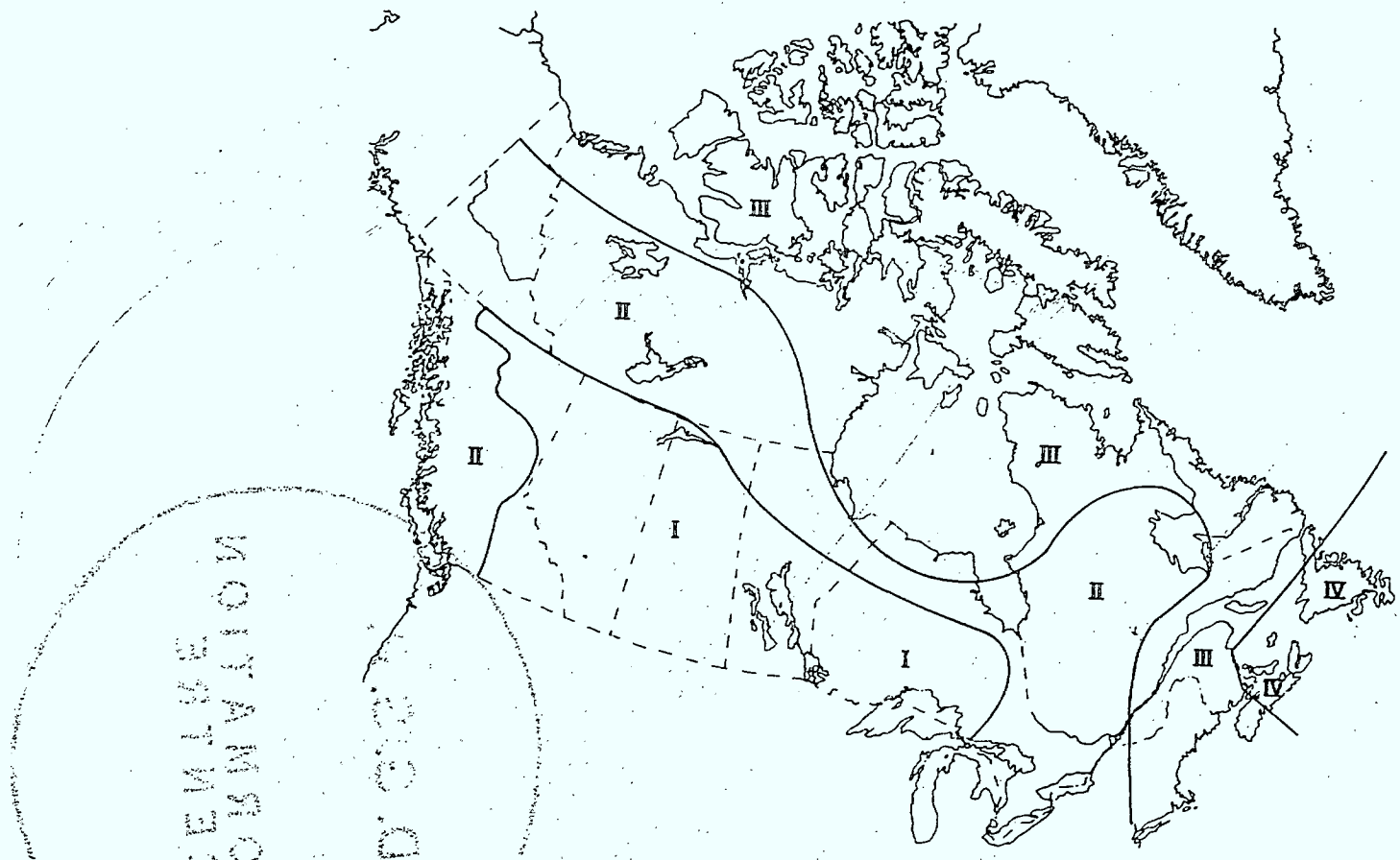


- APPENDIX C -

WIND AND ICE MAPS OF CANADA

DCB

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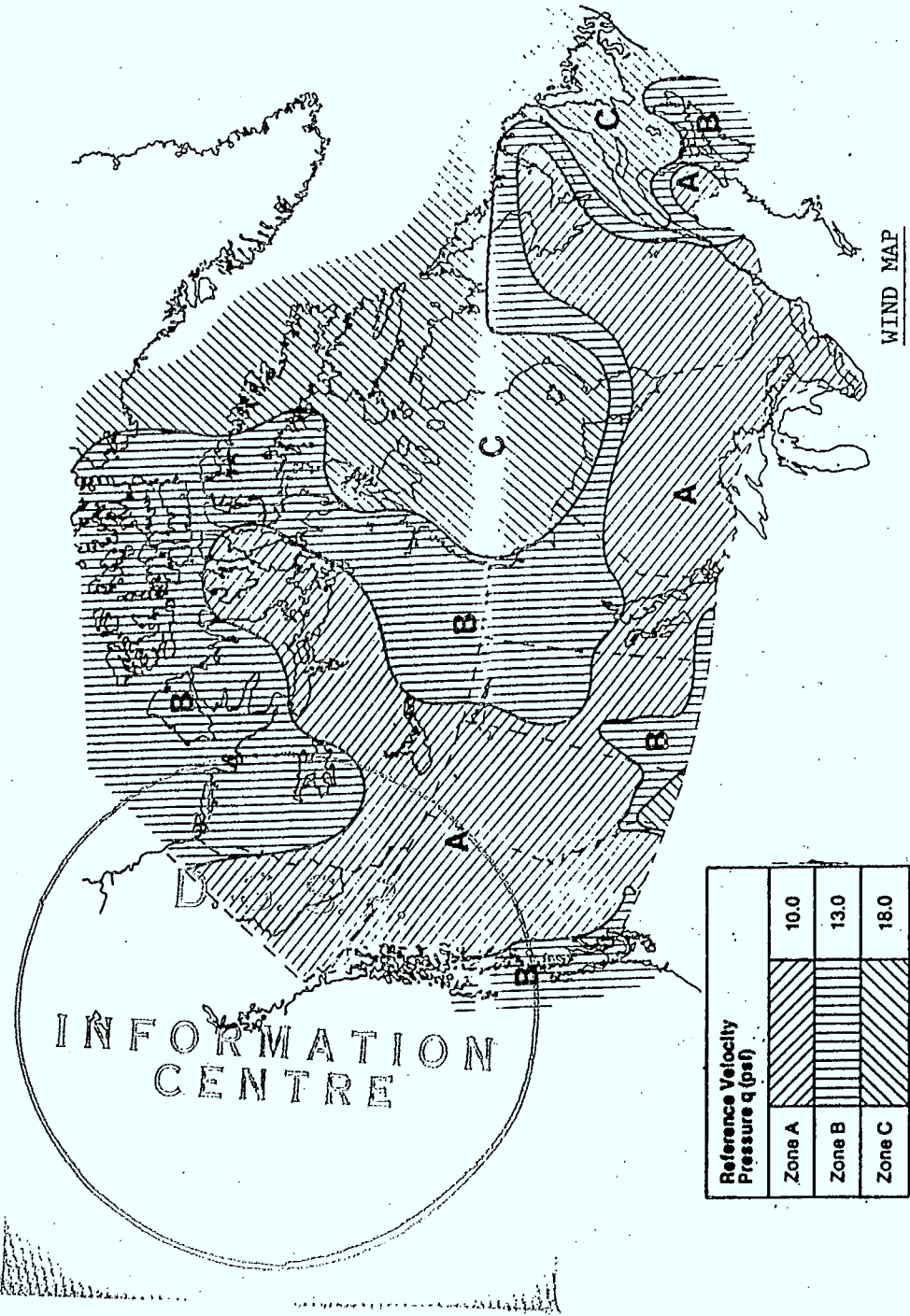


NATIONAL
 DEFENSE
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ICE LOADING ZONES

Class	Ice Thickness Inches
I	0.5
II	1.0
III	1.5
IV	2.0
V	Open

ICE MAP



WIND MAP

Reference Velocity Pressure q (psf)	10.0	13.0	18.0
Zone A			
Zone B			
Zone C			

