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Spectrum Management

Broadcasting Circular

Procedures for Qualification and Verification: Use of Aeronautical and Emergency Frequencies by Broadcasting Receiving Undertakings (Cable Systems)

Canada

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Notice

Broadcasting Circulars are issued for the guidance of departmental staff and are complementary to Broadcasting Procedures and Rules.

Foreword

Within the framework of the Broadcast Regulations and Standards Program of the Department, cable systems have been authorized to use certain aeronautical and emergency frequencies if the applicable operating conditions are met.

The Department and Transport Canada share certain aspects of the management of the aeronautical frequencies spectrum under the terms of an agreement which provides, among other things, that the Department shall consult Transport Canada before authorizing the use of aeronautical frequencies by cable systems.

In 1976, the two departments reached an agreement on the use of channels A, B and C. In 1985, studies were carried out on the use of channels A-1, A-2, 41 and 42. In August 1987, the Department introduced a regulation governing the use of aeronautical frequencies by cable systems. The provisions of the *General Radio Regulations* stipulate that the express authorization of the Department is required prior to any use of these frequencies, and that such use must be subject to and in compliance with the conditions set out in the system's Broadcasting Certificate. The regulation is reproduced in Appendix I.

In April 1986, an interim agreement concerning channels A-1, A-2, 41 and 42 was signed with the Department of Transport. The agreement stipulates that cable operators must meet certain operational and performance conditions before receiving authorization to use the channels in question.

It is therefore the Department's duty to ensure that these conditions are met. This will be accomplished through a qualification procedure. A verification procedure is also necessary to ensure compliance with all conditions after authorization has been granted. The Department must also protect certain frequencies used for search and rescue operations against harmful interference.

Purpose

The purpose of this document is to explain the qualification and verification procedures which the Department must follow in processing applications by cable systems to use aeronautical and safety frequencies.

Procedure

The details of the procedures are provided on the following pages.

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Part I

Conditions and Requirements concerning the Use of Protected Frequencies

1.1 Definitions

A few relevant definitions are assembled below:

Harmful interference denotes an adverse effect of electromagnetic energy from any emission, radiation or induction that endangers the use or functioning of a safety-related radiocommunication system, or that significantly degrades or obstructs or repeatedly interrupts the use or functioning of radio apparatus or radio-sensitive equipment.

CLI air-based criterion (CLI_a) denotes a signal leakage criterion used to estimate, from measurements taken in the airspace above the cable system, the cumulative impact of signal leakage on aeronautical frequency users. This performance criterion applies to cable systems carrying channels A-1(99), A-2(98), EE(41) and FF(42).

CLI ground-based criterion (CLI_g) denotes a signal leakage criterion used to estimate, from measurements taken on the ground, the cumulative impact of signal leakage on aeronautical frequency users. This performance criterion applies to cable systems carrying channels A-1(99), A-2(98), EE(41) and FF(42).

90th-percentile value of the field strength denotes, when all cable leakage data collected above a cable system are ranked in ascending order, the maximum field strength reading of the group composed of 90% of all the collected data.

Signal leakage or **leakage** denotes all electromagnetic energy escaping from a cable system.

1.2 Categories of Conditions concerning Protected Frequencies

1.2.1 Synoptic Table 1.1 shows cable channels, protected frequencies and their assignments.

1.2.2 The conditions concerning use of aeronautical frequencies fall into two categories. First, there are pre-conditions, i.e., the conditions and requirements which the cable operator must meet before receiving authorization to use protected frequencies. Once authorization has been granted, the operator must also comply with operating conditions, i.e., operating conditions and requirements that must be met as long as the cable operator continues to use aeronautical frequencies.

1.2.3 For international emergency frequencies and aeronautical marker beacons, the Department has prescribed the operating conditions and requirements that the cable operator must meet.

All these conditions and requirements are subject to verification by the Department.

1.3 Pre-conditions and Requirements concerning Aeronautical and Emergency Frequencies

1.3.1 All channels within the aeronautical bands

For all channels within the aeronautical bands, the pre-conditions and requirements are as follows:

- The operator must obtain the express authorization of the Department before beginning to use these frequencies. Applications must include detailed information on the carriers, maximum power levels and types of signals in question.

- The operator must establish a suitable program for maintenance, leakage control and response to interference problems, including regular leakage patrol.

- The system operator must keep a logbook indicating the date and location for each leak detected, the date on which it was repaired and its probable cause. This logbook must be kept for a period of two years so that it may be examined by an inspector from the Department upon request.

1.3.2 Channels A-1, A-2, EE and FF only

For channels A-1, A-2, EE and FF, the following pre-conditions and requirements are in addition to those described in 1.3.1 above.

- The operator must complete a leakage patrol indicating the CLI value of the system and submit the results to the Department with its application. This patrol should be carried out in accordance with the procedures described in Part 5 of "Broadcasting Procedure No. 23, Issue 4".

- The operator shall submit to the Department, with its application, urban maps of the cable system showing the system boundaries and the old and new aerial and underground cable sectors, etc.

- The cable operator's leakage patrol procedure and the maintenance and response to interference problems programs must be verified by the Department.

- The leakage performance of the system must be verified by the Department and must comply with the applicable leakage criteria.

Table 1.1

Protected Frequency Bands

Cable Television Channels	Protected Frequency Bands (MHz)	Allocation
1 (A-8) (between channels 4 and 5)	74.8 - 75.2 (centre frequency: 75)	Aeronautical radionavigation (ILS marker beacon)
98 (A-2) 99 or (A-1)	108 - 117.975	Aeronautical radio-navigation (ILS localizer)
14 (A) 15 (B) 16 (C)	117.975 - 137	Aeronautical mobile (air/ground communication)
41 (FF) 42 (FF)	328.6 - 335.4	Aeronautical radionavigation (ILS glide slope)
14 (A)	121.45 - 121.55 (centre frequency: 121.5)	Aeronautical emergency
20 (G)	156.7625 - 156.8375 (centre frequency: 156.8)	Maritime mobile (distress and calling)
27 (N)	242.95 - 243.05 (centre frequency: 243.0)	Aeronautical emergency
54 (RR)	406 - 406.1	Mobile - Satellite (Emergency position indicating radiobeacon)

- The operator must have the necessary equipment for measuring the frequency and stability of the carriers in question.

- The operator must put in place a safety procedure in case of interference with radionavigation systems operating in the 108 MHz to 118 MHz and 328.6 MHz to 335.4 MHz bands. This procedure is subject to Industry Canada approval and must call for the immediate removal of any interfering cable service(s) or channel(s) causing interference to these frequencies.

1.3.3 International Emergency Frequencies and Aeronautical Marker Beacons

The cable operator must put in place a safety procedure in case of interference to the international emergency frequencies of 121.5 MHz, 156.8 MHz, 243.0 MHz, 406-406.1 MHz and the aeronautical marker beacon frequency of 75 MHz. This procedure must call for the immediate removal of any interfering cable service(s) or channel(s) causing interference to these frequencies.

1.4 Operating Conditions and Requirements concerning Aeronautical Frequencies

1.4.1 All Channels Within the Aeronautical Bands

The operating conditions and requirements concerning all channels within the aeronautical bands are as follows:

- The operator must have the necessary equipment to obtain and maintain the required offsets.

- The operator must comply with the operating conditions concerning frequency offsets and maximum power levels.

- If the assignment of new aeronautical frequencies or changes in service volumes of existing aeronautical frequencies result in an incompatible frequency relationship between these assignments and carriers on channels A-1, A-2, A, B, C, EE and/or FF, the system operator will be required to take the necessary measures to offset the carriers of the channels in question, as specified by the Department.

- If the conditions applicable to aeronautical frequencies are no longer being fulfilled, the system operator must immediately take the necessary steps to correct the situation.

1.4.2 Channels A-1, A-2, EE and FF Only

The operating conditions and requirements concerning channels A-1, A-2, EE and FF, which are in addition to those described in 1.4.1 above, are as follows:

- At all times, the cable television system must meet the leakage criteria applicable to aeronautical frequency users.

- The system operator must take measurements at least once a month to ensure that the required offsets are being maintained. These measurements must be recorded in a logbook so that it may be examined by an inspector from the Department upon request. Furthermore, this logbook must also be submitted to the Department on a yearly basis.

- In the year immediately preceding the expiration of the cable system Broadcasting Certificate, the operator must submit a report to the Department on its cable leakage control activities. The report must indicate the amount of human and material resources devoted to maintenance and leakage patrol and to the repair of cable leaks. Also, the report must include the CLI of the system, based on recent measurements, along with the location, date of measurement and field strength of each of the readings used in the CLI calculation.

1.5 Conditions and Requirements concerning International Emergency Frequencies and Aeronautical Marker Beacons

1.5.1 The following conditions must be met by any cable operator using frequencies which overlap those used by the international emergency frequencies and aeronautical marker beacons.

- Cable signals shall not exceed 10^{-5} watts (28.75 dBmV, 75Ω) on average across a 25 kHz bandwidth in any 160 µsec period at any point in the cable system within 100 kHz of the international emergency frequency of 121.5 MHz and the aeronautical marker beacon of 75 MHz. In addition, cable signals shall not exceed 10^{-5} watts (28.75 dBmV, 75Ω) on average across a 25 kHz bandwidth in any 160 µsec period within 50 kHz of the emergency frequency 243 MHz and the emergency frequency band 406 to 406.1 MHz, at any point in the cable system.

- For systems operating in the vicinity of maritime mobile service stations, cable signals shall not exceed 10^{-5} watts (28.75 dBmV, 75Ω) on average across a 25 kHz bandwidth in any 160 µsec period within 50 kHz of the emergency frequency 156.8 MHz, at any point in the cable system.

1.6 Leakage Criteria

The Cumulative Leakage Index (CLI) estimates the cumulative impact of leakage on aeronautical spectrum users. When the signal leakage measurements are taken on the ground, the CLI ground-based criterion (CLI_g) is used. If the measurements are taken in the airspace above the cable system, the CLI air-based criterion (CLI_a) is used to estimate this impact.

Figure 1.1 provides a schematic illustration of the cumulative effect of leaks when an aircraft overflies the service area of a cable system.

1.6.1 CLI Ground-Based Criterion (CLI_g)

The computed CLI_g must not be over 64.

The CLI_g is calculated using the following formulas:

$$CLI_g = 10 \log \left\{ \frac{S}{D} \sum_{i=1}^{N} E_i^2 \right\} + F(S)$$

$$F(S) = 10 \log \left\{ \frac{91}{S} \left[\log \left(1 + \frac{S}{28} \right) \right] \right\}$$

where:

CLI_g	=	CLI ground-based criterion, taking into account the surface area of the system
F(S)	=	Correction factor for the surface area
E_i	=	Field strength of the i^{th} leak measured at 3 metres, in µV/m
S	=	Surface area covered by the cable system, in km^2
D	=	Surface area patrolled, in km^2
N	=	Number of leaks detected

While all leaks, regardless of magnitude, must be repaired, it is not necessary to take into account leaks of less than 50 µV/m at 3 metres when calculating the CLI_g.

The curve of the correction factor for the surface area F(S) is shown in Figure 1.2

1.6.2 CLI Air-Based Criterion (CLI_a)

The CLI_a is the 90th-percentile value of the field strength due to cable leaks and it must not exceed 10 microvolts per metre RMS at an altitude of 450 metres above the cable system's average ground level.

1.7 Frequency Offsets and Carrier Levels Requirements

Table 1.2 presents frequency offsets from aeronautical frequencies required by the Department when cable carrier levels exceed specified limits. These requirements are part of an interim agreement reached with the Department of Transport in April 1986 and are subject to change.

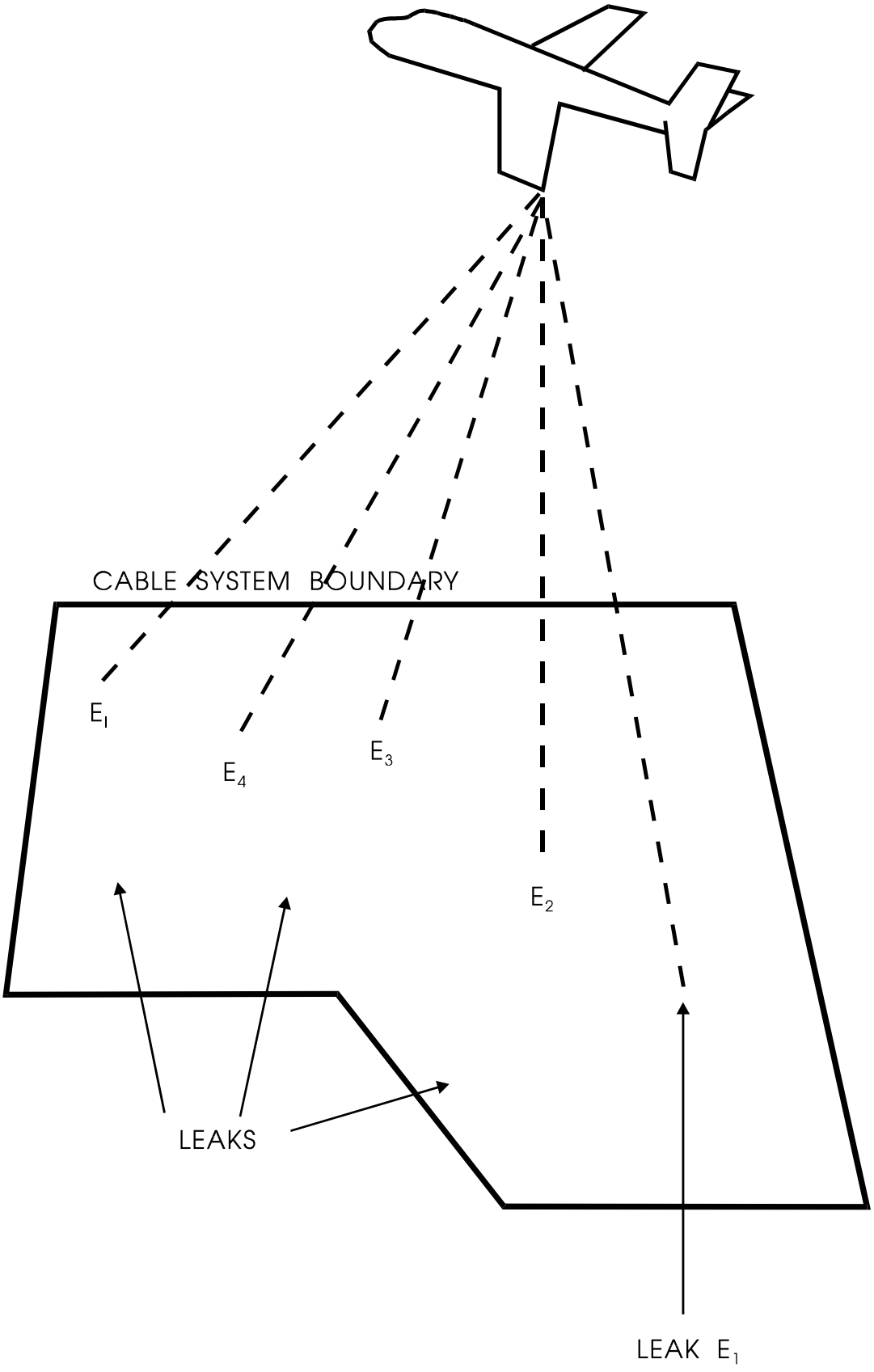

Figure 1.1 Cumulative effect of leaks

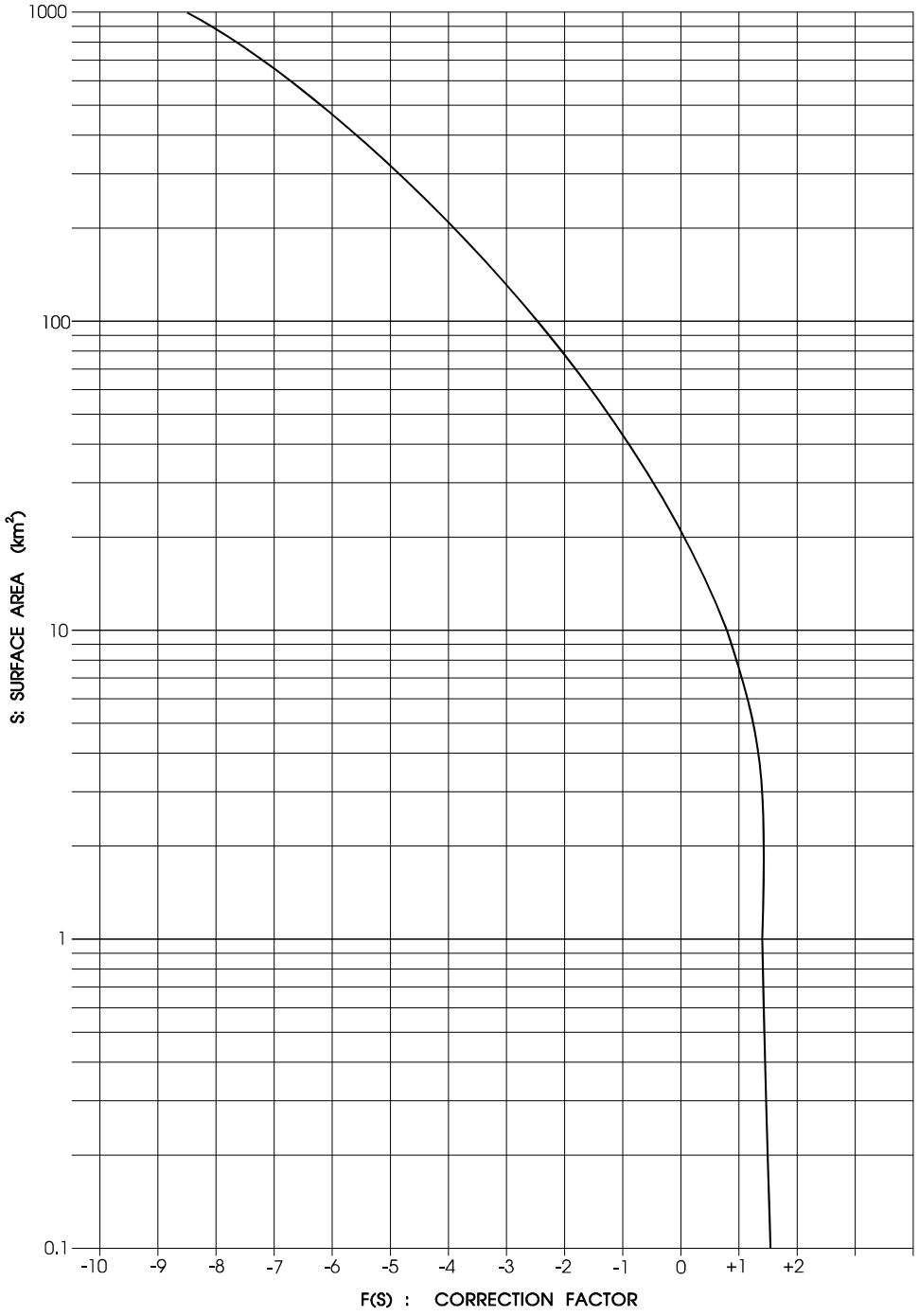

Figure 1.2 Correction curve of the CLI, taking into account the surface of the service area

Table 1.2

Power and Frequency Offsets

Frequency Bands	**Department** Interim Agreement (April 1986)		
	Power (Watts)	**Minimum Offsets (kHz)**	**Protected Area (nautical miles)**
108 - 112 MHz Localizer (LOC, TVOR) (A-2 or 98)	Carrier $> 10^{-5}$ peak Random Signal $> 10^{-4}$ average Notes 1, 2, 3	70 + tolerances	S.V. + 25 n.m. Note 6
112 - 118 MHz Localizer (EVOR) (A-1 or 99)	Carrier $> 10^{-5}$ peak Random Signal $> 10^{-4}$ average Notes 1, 2, 3	70 + tolerances	S.V. + 25 n.m. Note 6
118 - 137 MHz Communications (A or 14; B or 15; C or 16)	Carrier $> 10^{-4}$ peak or average Notes 4, 5	70 + tolerances	S.V. + 25 n.m. Note 6
225 - 328.6 MHz Military	No offset required	N/A	N/A
328.6 - 335.4 MHz Glide Slope (G.S.) (41 or EE) (42 or FF)	Carrier $> 10^{-5}$ peak Random Signal $> 10^{-4}$ average Notes 1, 2, 3	150	S.V. + 25 n.m. Note 6
335.4 - 400 MHz Military	No offset required	N/A	N/A

Notes:

(1) All carriers with peak power $> 10^{-5}$ watt (28.75 dBmV, 75Ω) must be offset. No discrete component $> 10^{6}$ watt (18.75 dBmV, 75Ω) must fall on any aeronautical carrier frequency. Maximum peak power allowed is 10^{-3} watt (48.75 dBmV, 75Ω).

(2) No frequency offset required when power level is $\leq 10^{-4}$ watt (38.75 dBmV, 75Ω), (average 25 kHz/160 µs) for random-type signal.

(3) Authorization required for channels A-1, A-2, 41, 42. Authorization granted after verification of leakage performance and patrol procedure.

(4) No frequency offset required when power level is $\leq 10^{-4}$ watt peak or average (across 25 kHz/160 μs). Conditions applied only up to 136 MHz when the agreement was signed.

(5) Written authorization required for channels A, B and C.

(6) Service Volume (S.V.) + 25 nautical miles.

Part 2

Applications

2.1 General Provisions

Operators must submit applications to use any frequencies within the 108 to 137 MHz and 328.6 to 335.4 MHz bands. To use the channels encompassing all or part of the international emergency frequencies 156.8, 243 and 406 to 406.1 MHz, cable operators are not required to submit applications to the Department. However, they must comply with the operating conditions and requirements applicable to these frequencies.

2.2 Applications for Channels A, B and C

Applications for channels A, B and/or C are processed differently from applications for the other aeronautical channels. The Department must ensure that all the pre-conditions are met before granting authorization to use these frequencies. It is not necessary to conduct a qualification inspection or a leakage patrol as in the case of the other aeronautical channels. When the pre-conditions have been met, the regional office so advises headquarters, which determines the offsets, where applicable.

2.3 Applications for Channels A-1, A-2, EE and FF

2.3.1 For these channels, the Department must follow a qualification procedure to ensure that all the pre-conditions have in fact been met. This qualification procedure includes a departmental evaluation of the system's leakage monitoring program and a leakage patrol by the Department to evaluate its CLI. The results and observations collected must then be forwarded to headquarters with comments and recommendations.

2.3.2 This qualification procedure and the related tasks are described in detail in the following sections. Figure 2.1 provides a flow chart of the procedure and related tasks.

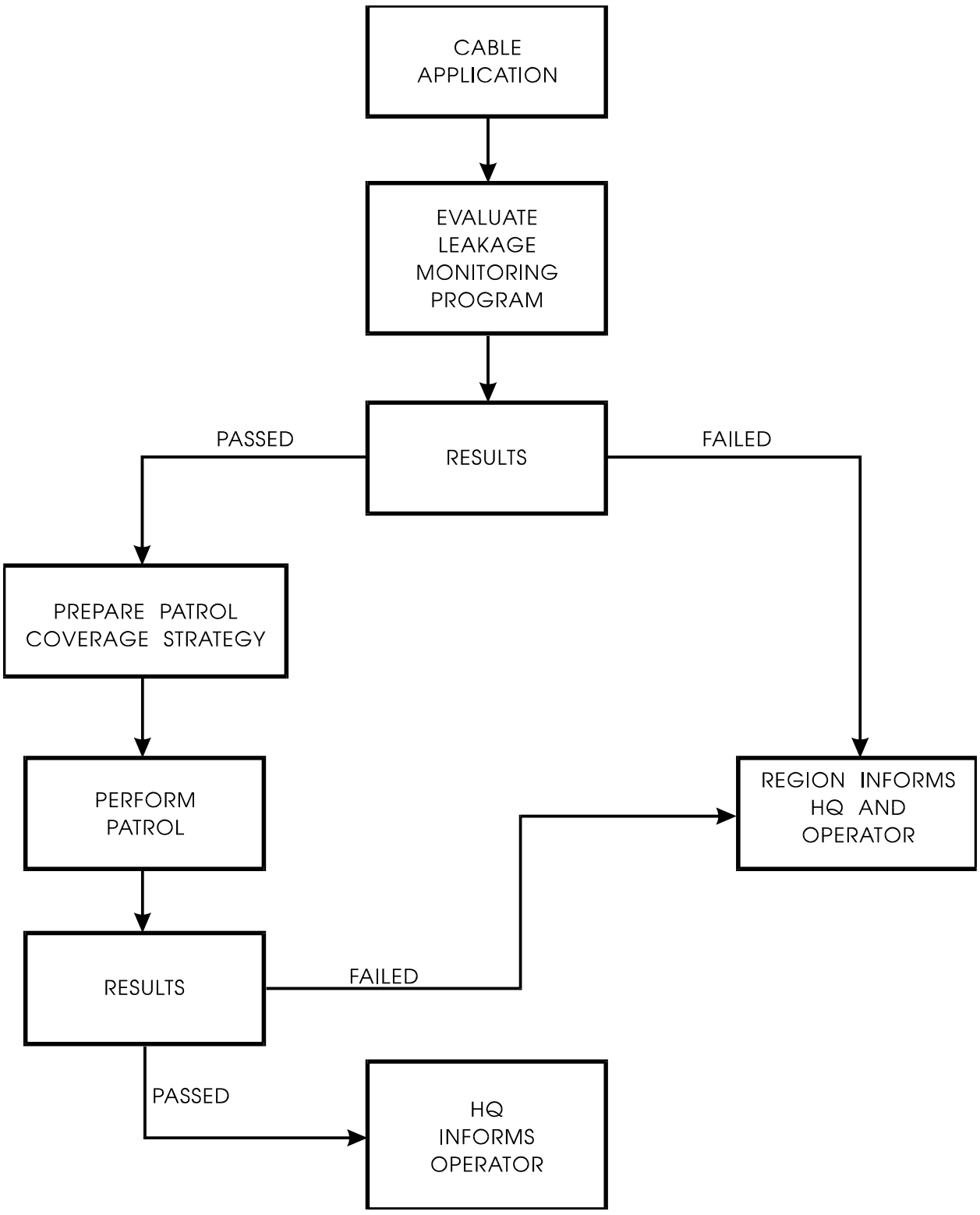

Figure 2.1 Flow chart of tasks in the qualification process

Part 3

Evaluation of the Leakage Monitoring and Response to Interference Problems Program

3.1 Preparation

3.1.1 Evaluation of the leakage monitoring and response to interference problems program constitutes the first part of the qualification process.

3.1.2 Before initiating the qualification process, care must be taken to ensure that the applicant has submitted all the required information with the application. The inspector in charge of evaluating the leakage monitoring program should review the information on file, such as previous inspection reports, correspondence, directed investigation reports, etc. to become thoroughly familiar with the system.

3.2 Evaluation

3.2.1 The purpose of the evaluation of the leakage monitoring program is to ensure that the operator has the facilities, equipment and expertise necessary to perform this task properly. The inspector must ascertain the monitoring technique, the number of vehicles assigned to patrols on a full- or part-time basis, the calibration techniques, etc. Also, the leakage logbook must be examined for compliance and the inspector must ensure that the claimant has the necessary equipment for measuring the frequency and stability of the carriers.

3.2.2 The inspector must also review the system maintenance and response to interference problems program. This program must also include a safety procedure in the event of interference with aeronautical radionavigation systems. The operator must submit to the Department a description of the program for responding to interference problems on aeronautical navigation frequencies. This document must be discussed with the applicant. Any relevant documentation on these topics must be collected and discussed with the cable operator and be included in the qualification report.

3.2.3 The inspector may also request a demonstration of the leakage monitoring technique and take note of the expertise demonstrated.

3.3 Qualification Report

The data collected are reported on Form 16-935 - ***Broadcasting Receiving Undertakings (Cable Television) - Inspection, Qualification and Verification Report.*** All relevant documentation supplied by the cable operator must be added to the report. This report, once completed, must be sent to headquarters. Form 16-935 is reproduced in Appendix II.

Part 4

Evaluation of Leakage Performance

4.1 General Provisions

4.1.1 The second part of the qualification program involves evaluating the leakage performance of cable systems. The leakage performance of the system is evaluated by measuring a leakage criterion called CLI. If the CLI is calculated using ground-based measurements, it is referred to as the CLI ground-based criterion, or CLI_g. When the CLI is measured directly from the air, it is referred to as the CLI air-based criterion, or CLI_a.

4.1.2 Although the Department is equipped only for CLI_g measurements, using the CLI_a criterion to evaluate the performance of a system is not precluded. The next two parts of the document will deal with the measurement procedures for these criteria and their application to determine whether a system qualifies to use aeronautical frequencies. Section 4.2 describes the CLI_g measurement procedure. The CLI_a measurement procedure is described in Section 4.3.

4.2 CLI_g Measurement Procedure

4.2.1 Preparation

4.2.1.1 It is important to note that the CLI_g should be measured only if the system meets the requirements of the first part of the qualification program, i.e., if the leakage monitoring and response to interference problems programs are deemed to be adequate. Furthermore, care must be taken to ensure that the applicant has submitted to the Department, with its initial application, all the required information, namely the results of the applicant's leakage patrol indicating the system's CLI as well as a map indicating the system boundaries and the aerial and underground cable sectors. If the information required is not acceptable, the operator must be contacted to obtain the missing information.

4.2.1.2 The results of the patrol performed by the operator must be analyzed by the Department. If the leakage performance appears to be acceptable, patrol preparations may be initiated in the Department. If the results indicate marginal leakage performance, the Department should ask the operator to make the necessary repairs and submit new patrol results.

4.2.1.3 Whenever possible, verifying the leakage performance of a system that has little or no chance of passing should be avoided. The Department's task is to ensure, by making its own measurements, that the system does indeed meet the applicable leakage requirements, having first established that the system is a good candidate.

4.2.2 Patrol Planning

Once it has been determined that the system is a good candidate, the planning of the patrol per se may begin. It is preferable to select a channel in the midband or channel 6 or 7, as appropriate. The level of the selected signal should be verified to ensure that it is at the same level as the other neighbouring carriers. A recent road map of the system to be patrolled must be obtained. The coverage area of the system must also be calculated.

4.2.3 Equipment Required

The following basic equipment is required for this patrol:

(1) A half-wave dipole antenna tuned to a midband visual carrier or channel 6 or 7, as appropriate. The antenna must be installed on top of the patrol vehicle, at a height of at least 1 metre above the roof. The antenna elements must be oriented parallel to the cable installation.

(2) The field strength meter or other instrument used to detect leaks should have the following minimum characteristics:

sensitivity	< 2 µV
frequency-setting error	< 1 kHz
IF bandwidth at - 6 dB	< 50 kHz
voltage indication error	< 2 dB

4.2.4 Patrol Strategy

4.2.4.1 Before beginning the Department's patrol, the inspector should prepare a patrol strategy. This strategy consists of identifying in advance the areas to be patrolled. For this purpose, the inspector should use maps showing the system boundaries and the sectors of older and newer aerial and underground cables, etc. This information should accompany the application submitted by the cable operator. It is important that this data be as up-to-date and precise as possible.

4.2.4.2 The system should be divided into sectors that are as homogeneous as possible.

These various sectors may be as follows:

- newer aerial cable sector
- older aerial cable sector
- underground cable sector
- rebuilt sector
- apartment building sector
- fibre optic sector
- etc.

4.2.4.3 These sectors should in turn be subdivided into smaller zones that can be used as patrol zones. These patrol zones or units should be divided up, insofar as possible, by using natural divisions, such as neighbourhood boundaries, rivers, parks, etc. The selected zones should have approximately the same area from one sector to another.

4.2.4.4 Once the subdivision of the sectors into zones has been completed, the inspector should select one or more zones in each sector. The number of zones selected should be equivalent for each sector. The selected zones are to be patrolled completely. The area of the selected zones must also be calculated. The total surface of the selected zones should represent at least 25% of the area to be serviced by the aeronautical channels.

4.2.4.5 The diagram in Figure 4.1 illustrates the strategy for selecting the zones to be patrolled. In this example, the system has been divided into three sectors. In turn, each sector was subdivided into zones. The hatched zones are to be patrolled completely. The time spent on patrol preparation will greatly reduce the time and effort required to accomplish this task.

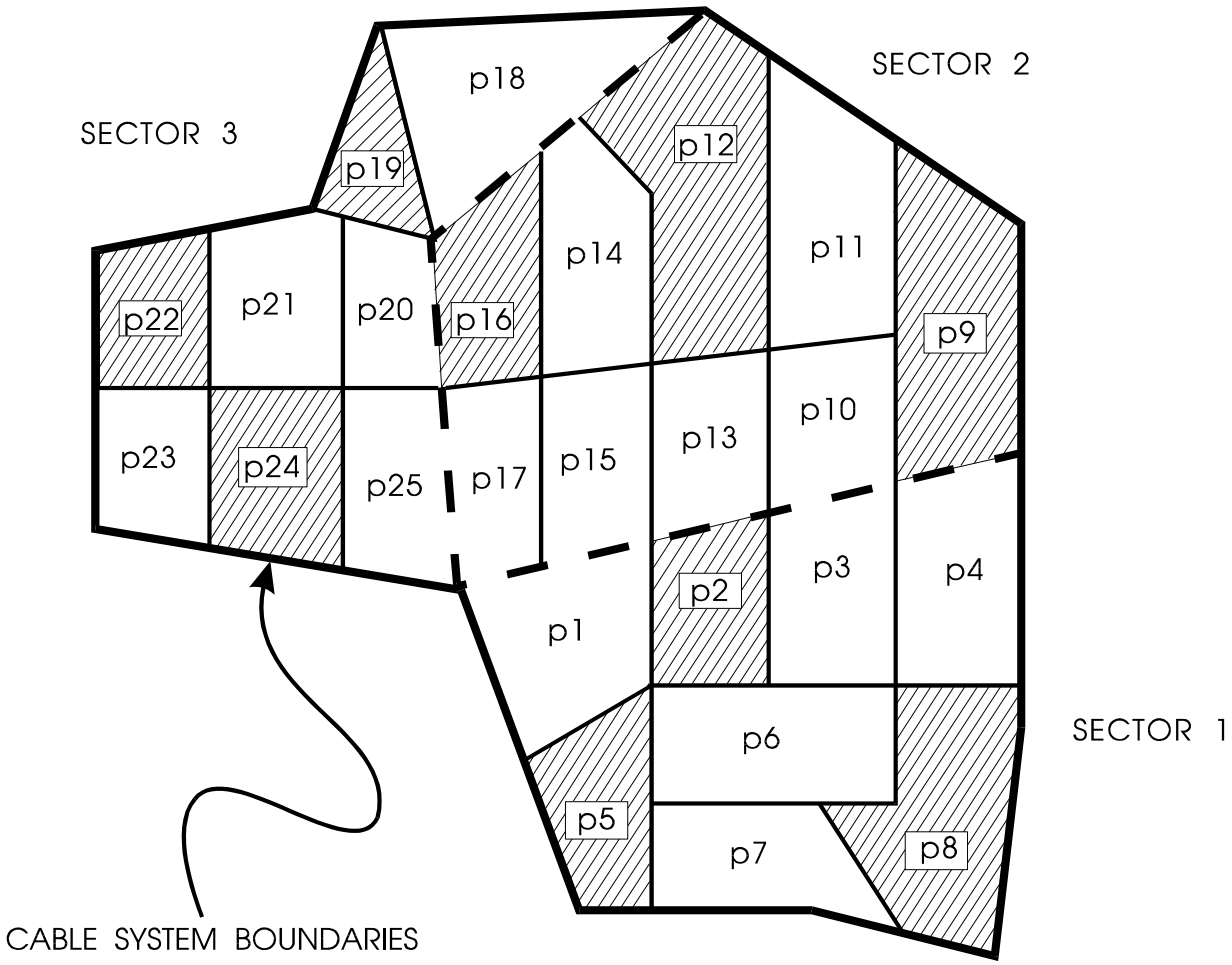

Figure 4.1 Example of a patrol strategy

4.2.4.6 If a selection strategy for zones and patrols is not prepared, then at least 75% of the system area must be patrolled.

4.2.4.7 The patrol vehicle should be driven at no more than 20 km/hr through the patrol zone. When a leak is detected, attempt to maximize the field strength reading by moving the vehicle, without getting out. Only leaks greater than 50 µV/m need be taken into account, and it is not necessary to spend a great deal of time attempting to maximize readings in the vicinity of 100 µV/m.

4.2.4.8 However, any leak greater than 500 µV/m should be measured carefully. Major leaks have a much greater impact on the value of the CLI than smaller ones. Record the level in µV/m standardized at a distance of 3 metres from the cable.

4.2.4.9 When the cable runs parallel to the route travelled, it should be assumed that the distance between the antenna and the leak is approximately 3 metres. The vehicle should be driven on the side of the road where the cable is located. If the cable is behind dwellings, a correction factor of 10 dB must be added to the obtained reading. Also note the approximate address of the leak. However, it is not necessary to localize the source of the leak. A general indication is sufficient.

4.2.4.10 From time to time during the patrol, the inspector should calculate the value of the CLI. If after a certain period of time, it is clear that the CLI will not be exceeded, the patrol may be terminated without having to cover 25% of the system area.

4.2.4.11 Likewise, as soon as the CLI limit is exceeded, the patrol should be terminated, since the system has failed. However, efforts should be made to avoid this eventuality by insisting on data as complete as possible on the leakage performance of the system from the operator before beginning the patrol. If the data are incomplete or unsatisfactory, the patrol should not be undertaken.

4.2.4.12 In spite of information from the operator indicating that the CLI_g will not exceed 64, there may also be cases where the CLI_g remains close to the limit of 64. In this case, it may prove necessary to patrol more than 25% of the surface of the system to determine the value of the CLI.

4.2.4.13 Figure 4.2 is a flow chart of the CLI_g patrol. The CLI_g measurement procedure, as presented in Part 5 of ***BP23, Issue 4***, is reproduced in Appendix III.

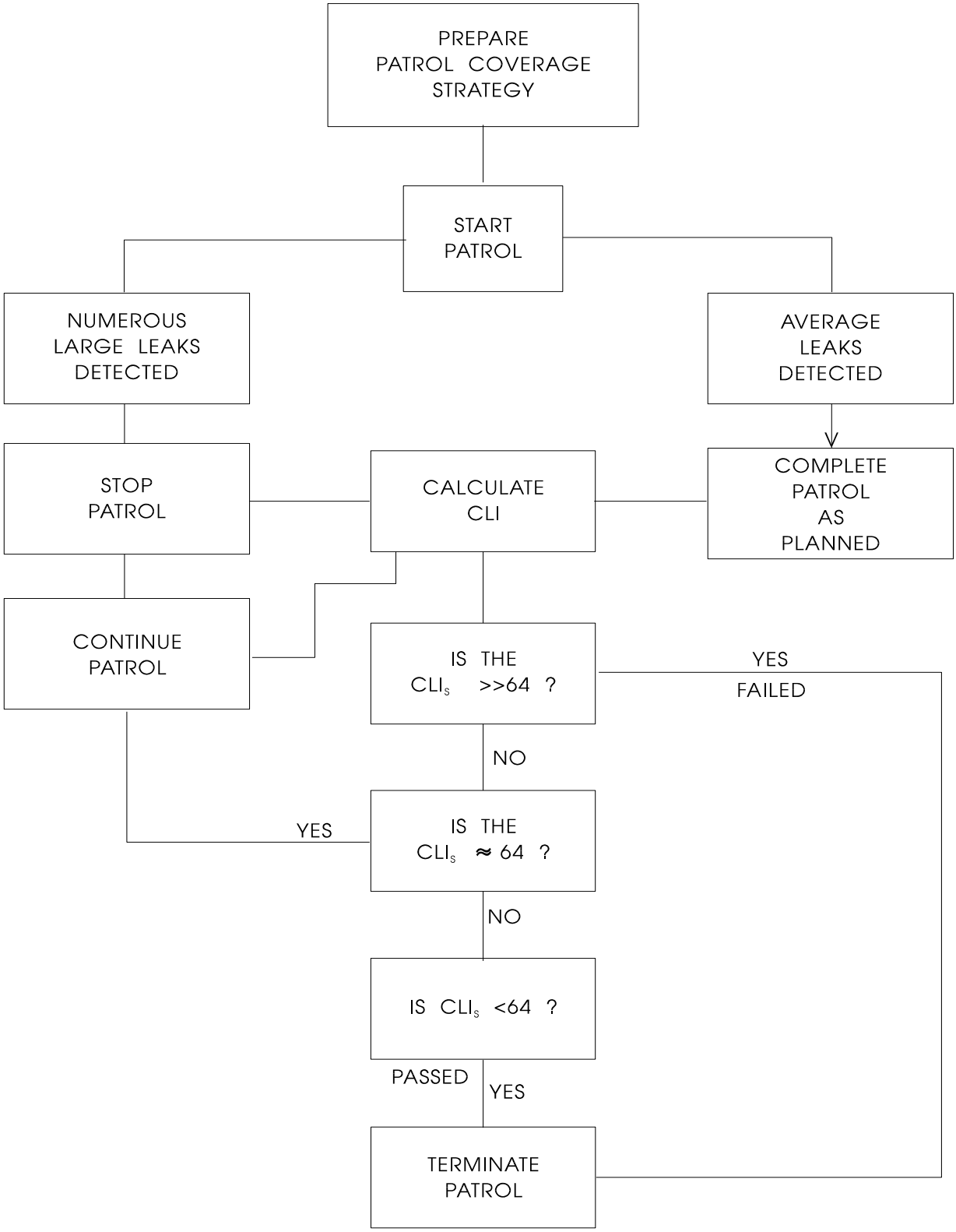

Figure 4.2 Department's CLI_s patrol procedure

4.2.5 Qualification Report

4.2.5.1 The results of the Department's leakage patrol should be reported on Form 16-935. Maps indicating the patrol strategy and the list of equipment used should also be added. The inspector should add any relevant comments on the leakage monitoring and patrol program and sign the form.

4.2.5.2 Regional office staff should review and evaluate the data collected and indicate whether or not the system should be granted the requested authorization.

4.3 CLI_a Measurement Procedure

4.3.1 General Provisions

Since the cable industry now has access to the equipment required to make aerial measurements of the CLI_a, the Department will review any application accompanied by the results of such measurements. Although the equipment in question is not available to the Department, the Department is able to evaluate the validity of the results. Measurements should be carried out in accordance with the procedure described in Part 5 of **BP23, Issue 4**, which is reproduced in Appendix IV of this document.

4.3.2 Analysis and Verification

4.3.2.1 The same analysis and verification procedure described previously applies when the cable operator uses a CLI_a measurement to support its application.

4.3.2.2 The results of the measurement and the procedure used should be evaluated. If the data supplied are not fully satisfactory to the inspector, clarifications should be sought from the operator. The application and the CLI_a measurement report submitted by the operator should contain all the information requested.

4.3.2.3 The qualification process, which includes verification of the leakage monitoring and performance program, should not be undertaken until it has been established, with the maximum possible certainty, that the applicant has a good chance of qualifying.

Part 5

Procedure for Master Antenna Television Systems (MATV)

5.1 General Provisions

Master Antenna Television systems (MATV) are exempt from the requirement to hold a Broadcasting Certificate, provided, among other things, that they neither use nor distribute signals in the 108 MHz to 137 MHz or 328.6 MHz to 338.4 MHz frequency ranges. The regulation is reproduced in Appendix V. However, it is conceivable that a system of this type may wish to use these frequencies. In such instances, an application must be submitted and the qualification and verification procedure should be followed for the system in question.

5.2 Qualification Procedure

5.2.1 Although often much less extensive than traditional cable systems, Master Antenna Television systems are capable of causing harmful interference to aeronautical frequencies.

5.2.2 The operator of a Master Antenna Television system who wishes to use signals in the 108 MHz to 137 MHz or 328.6 MHz to 338.4 MHz frequency ranges must therefore provide the same information requested of a cable system operator. This information must be analyzed in the same way and the qualification procedure should apply.

5.2.3 The applicant should have the necessary equipment to measure and repair leaks and should conduct regular patrols. The system's leakage performance should be evaluated by the applicant and verified by the Department.

5.2.4 The CLI_g leakage criterion applies to Master Antenna Television systems. In such instances, the patrol must be carried out around the building, inside and on the roof, if accessible. For such situations, the entire surface of the system must be patrolled. The surface area covered must be measured and the F(S) correction factor must be applied, where appropriate.

5.3 Qualification Report

The Department's qualification report should be submitted on **Form 16-935**.

Part 6

Verification Procedure

6.1 General Provisions

6.1.1 Once the use of aeronautical frequencies has been authorized, the Department must ensure that the prescribed conditions continue to be adhered to.

6.1.2 This procedure also applies to Master Antenna Television systems authorized for aeronautical frequencies.

6.1.3 The verification procedure is modeled on the qualification procedure. It should include a visit to verify the equipment used for leakage control and for measuring frequency offsets. It should also include a leakage detection patrol by the Department. The verification results should be reported on Form 16-935.

6.2 Verification of Facilities - Cable and MATV Systems

6.2.1 An inspector from the Department should visit the facilities of the cable television system. Prior to the visit, the inspector should review the most recent qualification or verification report concerning the system in question.

6.2.2 For the year immediately preceding the expiry of the cable system Broadcasting Certificate, the operator must send to the Department a report on its cable leakage control activities as well as the results of a recent measurement of the system's CLI. The inspector should consult this report, when available, and be ready to discuss it with the operator.

6.2.3 The inspector should verify that the leakage detection patrol equipment is present and in good operating condition. He should also examine the leakage control logbook. He should take measurements to verify that the prescribed offsets are being maintained and that the maximum power levels are not exceeded. The inspector should also ensure that the operator has not expanded the area served by aeronautical frequencies without requesting authorization.

6.2.4 The cable television operator must keep a logbook in which the results of the monthly frequency and level controls are recorded. The inspector should examine this logbook.

6.2.5 The inspector should verify that all the power and offset requirements applicable to international emergency frequencies and aeronautical marker beacons are met.

6.2.6 Where applicable, the inspector should consult the maritime mobile database to find out if the cable system is operating in the vicinity of a maritime mobile station.

6.2.7 The operator should put in place a safety procedure in case of interference with radionavigation systems operating in the 108 to 118 MHz and 328.6 to 335.4 MHz bands, with international emergency frequencies 121.5 MHz, 156.8 MHz, 243.0 MHz and 406-406.1 MHz and with the aeronautical marker beacon frequency of 75 MHz. The inspector should evaluate this safety procedure and ensure that it is still adequate and functional.

6.3 Verification of Leakage Performance

6.3.1 For the purposes of the verification procedure, approximately 10% of the system coverage area should be patrolled. Representative locations should be selected and the CLI_g measurement procedure described in **BP23, Issue 4** should be followed.

6.3.2 It is possible to carry out two separate visits, one to measure cable leakage and one to verify the facilities.

6.4 Verification Timetable

Systems which use aeronautical frequencies must be followed up one year after receiving the initial authorization and every two years thereafter.

Appendix I

Regulations Governing the Use of Aeronautical Frequencies

General Radio Regulations, Part II

Part IX

135. No person shall operate or permit the operation of a cable distribution system as part of a broadcasting receiving station on any radio frequency or band of radio frequencies within the radio frequency range from 108 MHz to 136 MHz or from 328.6 MHz to 335.4 MHz, unless:

(a) the Minister, in a broadcasting receiving technical certificate issued under subparagraph 4(1)*(b)*(ii) of the Act, has expressly authorized the broadcasting receiving station to operate the cable distribution system on that radio frequency or band of radio frequencies; and

(b) that radio frequency or band of radio frequencies is used by the broadcasting receiving station subject to and in accordance with all the conditions, including those conditions that relate to the use of that radio frequency or band of radio frequencies, specified in the broadcasting receiving technical certificate referred to in paragraph *(a)*.

Appendix II

Inspection, Qualification and Verification Report

BROADCASTING RECEIVING UNDERTAKING (CABLE TELEVISION)

Government of Canada

INSPECTION, QUALIFICATION AND VERIFICATION REPORT

Industry Canada

Note :

(1) For inspection reports, refer to the procedure in Broadcasting Circular 20.

(2) For qualification and verification reports, refer to Broadcasting Circular 12.

SECTIONS A TO F ARE TO BE COMPLETED BY THE INSPECTOR

INSPECTION REPORT _____	File No :
VERIFICATION REPORT _____	Certificate No :
QUALIFICATION REPORT _____	Expiry Date :

A - GENERAL

Licensee	Tel. Number : (___) _____ Fax Number : (___) _____
Address	Postal Code :
Name of Chief Technician or Engineer	Tel. Number : (___) _____ Fax Number : (___) _____

Number of Connected Subscribers	Number of Channels Used (Total)	Is this a Master Antenna Television system (MATV)?	Localities served by the system :
Number of Potential Subscribers	List Channels Overlapping Aeronautical Bands	____ YES ____ NO	

Is this the first qualification report for this system? ____ YES ____ NO

If not, date of last report _____

B - SITE EVALUATION AND COMMENTARIES ON SAFETY ASPECTS

Comment on any changes to the head-site and on any safety related aspects noted during the inspection. Outline significant changes from previous reports, where applicable.

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C - EVALUATION OF LEAKAGE MONITORING AND RESPONSE TO INTERFERENCE PROBLEMS PROGRAMS

(a) Technique employed (cuckoo, etc.)

(b) Frequency used _____ MHz

(c) Number of vehicles equipped with receivers _____

(d) Is the equipment shared with another system? Yes ____ No ____

If so, which system(s)? _____

(e) Does the operator have the equipment required to measure and maintain the accuracy of the required offsets?

Explain :

(f) Is there a leakage logbook? Yes ____ No ____

Comments :

(g) Is there an offset logbook? Yes ____ No ____

Comments :

(h) Give a brief description of the system's leakage monitoring program. This should include details of the reporting procedure, the average verification time, the types of equipment used, how often patrols are performed, how long it takes for the complete system to be patrolled, the availability of records and any other pertinent information. However, evaluation of a vehicle may be omitted from **verification reports** if the inspector is generally satisfied with the monitoring program. Include all pertinent information with this report.

(I) Give a brief description of the system's maintenance and interference problems response program. Describe the safety procedure in the event of interference with aeronautical radionavigation systems.

Include all pertinent documentation.

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D - EVALUATION OF LEAKAGE PERFORMANCE

Temperature _____ °C Weather Conditions _____ Date_____

Test Frequency _____ MHz Distance Patrolled _____km

Total Length of Cable Plant _____km Trunk _____ % Distribution _____ %

Note the level, indicate plant configuration (rear or front lot) and note approximate location of leaks.

Oedometer Start : _____km Time : Start : _____

Finish : _____km Finish : _____

No.	Level	Front Lot Plant	Rear Lot Plant	Patrolled Zone	Address	Comments

Use additional sheets as required.

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E - VERIFICATION OF OPERATING CONDITIONS

Channels (MHz)	Offsets		Protected Frequencies (MHz)	Are operating conditions being met? Explain if necessary.
	Required	Measured		
A			74.8 - 75.2	
B			121.5	
C			156.8	
EE			243	
FF			406 - 406.1	

F - SIGNATURE BLOCK

Inspector(s) Signature : _____ Telephone : (_____)_____

Date : _____ Fax : (_____)_____

- SECTIONS G TO I ARE TO BE COMPLETED BY REGIONAL STAFF -

G - LEAKAGE MONITORING PROGRAM ASSESSMENT

Using the inspector's description and any other applicable information, provide a brief assessment of the system's leakage monitoring program and its effectiveness. If applicable, discuss significant changes from previous report(s).

H - RECOMMENDATION

In your opinion, should this system be authorized to use or continue to use aeronautical frequencies?

YES ____ NO ____

I - SIGNATURE BLOCK

Regional Staff Signature : _____ Telephone : (_____)_____

Date : _____ Fax : (_____)_____

16-935(0293)E

Appendix III

Cumulative Leakage Index Ground-based Criterion (CLI_g) Measurement Procedure

Appendix III

Cumulative Leakage Index Ground-based Criterion (CLI_g) Measurement Procedure

1.0 Equipment Required

(1) a half-wave dipole antenna,
(2) a field strength meter (FSM), spectrum analyzer or receiver,
(3) a patrol vehicle.

2.0 Measurement Procedure

2.1 Operate the cable television system under standard operating conditions. As much as possible, this measurement should not be carried out when it rains.

2.2 Before the patrol begins, the antenna should be tuned to the visual carrier frequency of a midband channel, preferably channel A, B or C. If this is not feasible, channel 6 or 7 should be selected. The level of the selected carrier must be maintained at the level of the nearest video carrier.

2.3 The antenna must be installed on top of the patrol vehicle, at a height of at least one metre above the roof. The antenna elements must be oriented along the horizontal (front-to-back) axis of the vehicle to detect signals from either side of the street.

2.4 It is recommended that the field strength meter or other instrument used to detect leaks have the following minimum characteristics:

sensitivity	< 2 µV
frequency-setting error	< 1 kHz
IF bandwidth at - 6 dB	< 50 kHz
voltage indication error	< 2 dB

In addition, the frequency stability of the receiver must be sufficient to make frequency readjustment during the patrol unnecessary.

2.5 The calibration and operation of the measuring equipment must be checked before each patrol.

2.6 The patrol vehicle must be driven slowly - i.e., at no more than 20 km/hour - so that signals of low-intensity may be detected. When a leak is detected, the vehicle must be positioned and/or the antenna oriented in such a way as to obtain a maximum field strength reading. This value is recorded in µV/m. It must also be noted whether the leak is coming from a front- or rear-lot plant.

2.7 To take into account the distance between the antenna and the cable leak, a correction factor of 10 dB must be added to the field strength measurements of leaks originating from rear-lot cable plants.

2.8 No correction factor must be added to field measurements of leaks from front-lot cable plants. In such cases, drive the vehicle as close to the cable leak as possible, while attempting to maintain a distance of 3 metres between the antenna and the cable.

2.9 All factors influencing field strength readings, such as the antenna factor, losses in the cable linking the antenna to the field strength meter, mismatch losses and amplifier gain, if any, must be evaluated. All these corrections must be taken into account to obtain the final field strength readings and are in addition to the correction for distance discussed in 2.7.

2.10 Very large leaks (>500 µV/m) must be measured carefully, since they can greatly influence the CLI_g. However, for the purposes of CLI_g calculations, only leaks equal to or greater than 50 µV/m need be taken into account.

2.11 The dimensions of the cable television system, in square kilometres (km^2), must be obtained in order to calculate the CLI_g. The system dimensions correspond to the geographical surface area covered by the system. This surface may be measured using a geographical map, drawn to scale, showing the boundaries of the cable system service area.

2.12 Non-served areas such as city parks or industrial parks (completely surrounded by the service area and representing only a small fraction of the overall cable system area) are usually included in the surface calculation and considered to be leak-free areas for patrol purposes.

2.13 Areas demarcated by long rural branches - for example, a cable serving a rural route - are usually included in the surface calculation. A standard width of 1 kilometre should be used when the width of the trunk or branch is too narrow to be measured on the map.

2.14 The CLI_g measurement patrol should cover at least 25% of the surface area of the cable plant situated within the area covered by the Broadcasting Certificate. To ensure that the measurement procedure is reliable, the following patrol strategy has been defined:

- Identify the various system sectors on a map of the cable system. These sectors may be identified as the oldest sectors in the system, newer sectors, underground distribution sectors, aerial distribution sectors, etc.

- Each sector identified in this way must then be subdivided into smaller zones, in accordance with the natural divisions of the city, such as main streets, residential areas, etc.

- Next, samples from a certain number of zones in each sector must be taken. The sample area must represent at least 25% of the total surface of a given sector so as to provide an acceptable representative reading of the leakage in that sector.

- Each sample area selected must be patrolled completely - i.e., every street where single and/or multiple cables are installed must be covered.

- When the sample areas patrolled in each zone are added together, the total surface patrolled must equal at least 25% of the total service area of the cable television system.

2.15 If the patrol strategy detailed in 2.14 is not employed, at least 75% of the system's total surface must be patrolled for CLI_g assessment purposes.

2.16 To ensure accuracy, the time period for completion of the CLI measurement should not exceed four consecutive weeks, whenever possible.

2.17 The field readings and the surface of all the areas considered and patrolled are then used to calculate the CLI_g, according to the formula described in section 1.6.1 of this document.

2.18 If the CLI_g is close to the limit of 64, it will be necessary to increase the surface patrolled until the definitive CLI_g can be positively confirmed - i.e., until it is established that the CLI_g is indeed above or below 64.

2.19 There may be cases where the CLI_g for a given system is extreme, i.e., either very high or very low. In such cases, it may not be necessary to complete a patrol of 25% of the cable system surface to determine that the CLI_g is definitely above or below the limit of 64.

Appendix IV

Cumulative Leakage Index Air-Based Criterion (CLI_a) Measurement Procedure

Appendix IV

Cumulative Leakage Index Air-Based Criterion (CLI_a) Measurement Procedure

1.0 Equipment Required

Direct airborne measurement of the strength of the electromagnetic field present above a cable system requires the use of a measurement system especially designed for this purpose. The following list is generic and applies to any measurement system capable of direct field measurement from the air:

(1) a signal generator,
(2) a receiver connected to a portable computer,
(3) an antenna system,
(4) a ground navigation system,
(5) an aircraft.

2.0 Measurement Procedure

2.1 The purpose of airborne measurement is to obtain the 90th-percentile value of the field strength at 450 metres (1,500 feet) above a cable system. To take these readings, operators must install equipment designed and calibrated for this purpose on board an aircraft equipped with a suitable antenna. The aircraft must fly a grid pattern over the cable system in question. The equipment on board the plane must be able to detect and measure the electromagnetic field produced by a carrier introduced into the system being tested.

2.2 Operate the cable television system under standard operating conditions.

2.3 Select a carrier to be introduced into the cable system for aerial detection purposes. It is recommended that a carrier in the 108-137 MHz band be used, since this range of frequencies belongs to the aeronautical band. The operator should be careful not to select a frequency that is negatively trapped anywhere in the system or that is used as a pilot in a microwave link.

2.4 The operator must obtain a special short-term licence issued by the Department before being permitted to introduce a carrier within the 108-137 MHz band.

2.5 It should be noted that these frequencies, 108-137 MHz, are commonly utilized aeronautical frequencies. When they are used to measure the airborne field above cable systems, interference from signals transmitted by aircraft or control towers may occur occasionally. In such cases, it may be necessary to offset the carrier frequency introduced for airborne measurements. This offset is acceptable if it remains within the calibrated bandwidth of the airborne measurement equipment and antenna. It must be pointed out that, when permission to use a carrier frequency within the 108-137 MHz band is

requested, any offset that may be necessary to carry out the airborne measurements must be mentioned in the application to the Department.

2.6 The introduced carrier must remain unmodulated and be maintained at the RMS peak power level of the highest carrier transmitted over the system being tested.

2.7 The antenna should be tuned to the selected measurement frequency, and must be horizontally polarized, parallel to the body of the aircraft. In addition, the antenna's performance should not be hindered by its installation on the body of the aircraft or its connection to the measuring equipment. To accomplish this, the antenna must be mounted as far as possible from any large metallic sections of the aircraft and must have an unobstructed line of sight to the ground. The antenna must be able to resist mechanical stress caused by its being mounted on the outside of the aircraft, without its performance being compromised.

2.8 It should be noted that any structural modifications to the exterior of an aircraft, such as the installation of an antenna, requires a Certificate of Airworthiness issued by Transport Canada. In addition, the installation must be carried out by a certified aeronautical engineer.

2.9 The antenna and receiving system should be calibrated at regular intervals. The calibration procedure should be done by measuring, at an altitude of 450 metres, a 10 µV/m field transmitted by a ground-based antenna system.

2.10 It is recommended that the receiving system be able to detect signals of less than -100 dBm (2 µV, 50 Ω) to ensure that the field readings are accurate.

2.11 Because of the specific nature of airborne measurements, the instruments used to carry them out often have their own special characteristics. Therefore, it may be necessary for applicants to prove to the Department that their airborne measuring equipment is able to accurately detect and measure airborne field strength above cable systems. The Department will be able to make this type of assessment if it is provided with as much detail as possible on the characteristics of the equipment - i.e., input bandwidth, frequency tuning, selectivity, sensitivity, rejection, overload protection, input noise, gain, dynamic range, mechanical and temperature stability, and calibration method.

2.12 The aircraft flight speed and the sampling rate of the data collection instrument must be adjusted so that, on average, at least one valid reading is taken for every 100 metres or less of air travel.

2.13 Any suitable method may be used to record and present readings, provided that the data for each flight path are made available.

2.14 The aircraft must fly at an altitude of 450 or 900 metres. A correction factor of 1 dB must be added to data when readings are taken at 900 metres.

2.15 The aircraft must fly a grid pattern over the system being tested. The grid legs should be spaced approximately 1 kilometre apart and must not exceed 1.5 kilometres at an altitude of 450 or 900 metres.

2.16 The operator must be sure to clearly identify the cable system boundaries to avoid gathering data outside the service area.

2.17 All data gathered from outside the system boundaries must be eliminated before the 90th percentile of the field strength is calculated.

2.18 For purposes of this measurement, the exterior boundaries of the service area are defined as being located at approximately 500 metres beyond the end of the trunk or distribution network at the periphery of the service area.

2.19 For long in-line trunk networks feeding outlying areas with little or no service along the path of the trunk, the system boundaries are set at no more than 500 metres on either side of the trunk in question.

2.20 The report must contain the following information:

- the 90th-percentile value of the field strength measured at 450 metres (or corrected for that altitude above average ground level of the cable system being tested;
- the date(s) on which the tests began and ended;
- the weather conditions during the tests;
- the test frequency used for the airborne measurements;
- the altitude at which the readings were taken;
- the grid spacing;
- the date of the most recent calibration of the antenna and receiver system, a description of the calibration method employed and the results obtained;
- the name, address and telephone number of the person(s)/company performing the airborne measurement and of those who had them taken.

2.21 If a new instrument or an existing instrument that has undergone significant modification is used for the airborne measurement, the report must also contain the following information:

- a description of the antenna system and the measurement equipment;
- the characteristics and technical specifications of the receiver, the measuring instrument and the antenna;
- a description of the data collection, correction and recording method.

Appendix V

Regulations Applicable to Master Antenna Television Systems

General Radio Regulations, Part II

Part I

6. "(17) A radio apparatus is exempt from the application of subsection 4(1) of the Act in respect of a radio authorization in the form of a broadcasting certificate if the radio apparatus

(a) is installed, operated or possessed as part of a broadcasting receiving undertaking that is exempted from the requirement to hold a licence under the *Broadcasting Act*, as specified in Public Notice CRTC 1983-255, *Master Antenna Television Systems Licensing and Exemption*, as amended from time to time;

(b) is only capable of receiving radiocommunications; and

(c) does not distribute or utilize signals in the frequency range from 108 MHz to 137 MHz or from 328.6 MHz to 335.4 MHz."