Industry Canada Industrie Canada
Innovation, Science and Economic Development Canada
Innovation, Sciences et Développement économique Canada

BPR-2
Issue 43
XXXAugust 20215

Spectrum Management and Telecommunications

Broadcasting Procedures and Rules

Part 2: Application Procedures and Rules for AM Broadcasting Undertakings

Aussi disponible en français - RPR-2

Canada

Preface

Broadcasting Procedures and Rules BPR-2, issue 4, *Application Procedures and Rules for AM Broadcasting Undertakings*, sets forth specific requirements applicable to AM transmitters in the 525-1705 kHz band. This document prescribes the required information for filing broadcasting certificate applications and specifies the technical standards and requirements as well as operational terms and conditions applicable to analog and digital AM broadcasting undertakings. This issue replaces BPR-2, issue 3, dated February 22, 2016. BPR-2 should be applied in conjunction with BPR-1, *General Rules*.

~~Issue 3 of BPR-2 is hereby released.~~

The following~~Listed below~~ are the main changes:

- ~~Introduction of a new option to submit applications online.~~
- ~~Relocation of the section for On-Air Testing Procedure to Broadcasting Procedures and Rules BPR-1, Part 1: General Rules.~~
- ~~Introduction of Modulation Dependent Carrier Level technology.~~
- ~~Description of the procedure for the Ratio Method.~~
- ~~Introduction of a new section on Critical Hours protection in the band 1605-1705 kHz.~~
- transition to online applications by default and email applications only in special circumstances
- introduction of a new procedure for AM proof of performance using method of moments
- a new procedure for the adoption of in-band on-channel (IBOC) digital radio broadcasting
- other updates ~~have been made~~, including editorial changes and clarifications, as appropriate~~.~~

Issued under the authority of the Minister of Innovation, Science and Industry~~Economic Development Canada.~~.

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Contents

1 International ~~A~~agreements

AM broadcasting assignments in the bands 535-1605 kHz and 1605-1705 kHz in Canada are made in accordance with two sets of international agreements.

The first set includes the regional agreements for the medium frequency broadcasting service applicable to Region 2. These agreements are:

- The *Plan for MF broadcasting in Region 2, Rio de Janeiro, 1981* — hereinafter referred to as RJ81 — concerns the band 535-1605 kHz.

- The *Plan for use of the band 1605-1705 kHz in Region 2, Rio de Janeiro, 1988* — hereinafter referred to as Rio 1988 — concerns the band 1605-1705 kHz.

The second set includes the agreements ~~celebrated~~ between the Government of Canada and the Government of the United States. These agreements are:

- The *Agreement Between the Government of Canada and the Government of the United States of America Relating to the AM Broadcasting Service in the Medium Frequency Band* — hereinafter referred to as Canada/USA Agreement, 1984.

- The *Interim Working Arrangement Between the Federal Communications Commission and the Department of Communications Relating to the AM Broadcasting Service in the Medium Frequency Band and the Draft Agreement Between the Government of Canada and the Government of the United States of America Relating to the AM Broadcasting Service in the Band 1605-1705 kHz* — hereinafter referred to as Canada/USA Agreement, 1990.

The Canada/USA Agreement, 1990 is still in draft form. However, the Interim Working Arrangement makes the draft agreement operational except for special consideration to be given to adjacent channel protection. Note also, that, in this document, these two Canada-USA agreements are also referred to *together* as the *Canada/USA Agreements*.[1]

All of these international agreements govern common use of the broadcasting band in the region so that each country within the region may make effective use of the band with minimum interference between broadcasting stations. The governing principles are reflected in technical criteria which must be followed to avoid excessive interference. While the agreements are international documents, they are implemented in Canada for domestic use, together with additional domestic requirements, through ~~Innovation, Science and Economic Development (ISED) Canada's~~ Innovation, Science and Economic Development Canada's (ISED) *Broadcasting Procedures and Rules*.

AM broadcasting assignments in the band 525-535 kHz in Canada are made in accordance with the *Radio Regulations* of the International Telecommunication Union. Protection of other broadcasting assignments is based on the technical criteria of the *Canada/USA Agreement, 1984*.

[1] ~~The *Canada/USA Agreement, 1990* for the band 1605-1705 kHz is still in draft form. However, an Interim Working Arrangement makes the draft agreement operational except for special consideration to be given to adjacent channel protection.~~

Protection of non-broadcasting assignments is assured by case-by-case coordination with the operator of a Canadian assignment that may be affected (usually the Department of National Defence or the Coast Guard) or with the National Telecommunications and Information Administration (NTIA) in the United States. Broadcasting stations in this band are limited to 1 kW power during the day and 250 W at night.

Canada does not currently have a formal arrangement with the United States government for in-band on-channel (IBOC) digital AM radio broadcasting. Licensees will be subject to any future agreements between Canada and the United States regarding use of these systems, which may include modifications of previously authorized stations. Until such time, applicable provisions for the existing analog cross-border agreement will apply to IBOC digital assignments.

2 Applications for AM ~~B~~broadcasting ~~S~~stations in the ~~B~~band 525-1705 kHz

This section outlines the procedure to be followed in preparing and submitting technical information required in support of applications for AM stations in the band 525-1705 kHz.

2.1 Application ~~R~~requirements

An application to ISED~~the Department~~ for a broadcasting certificate shall be accompanied by an application to the Canadian Radio-television and Telecommunications Commission (CRTC) for a broadcasting licence, unless the application is exempt from CRTC licensing requirements. The two applications shall be filed simultaneously.

Although the CRTC has established criteria to exempt certain categories of AM broadcasting from its licensing requirements, ISED~~Innovation, Science and Economic Development Canada~~, because of spectrum management needs, maintains its requirements for the submission of technical applications.

This section describes the submissions that are required in support of applications for AM broadcasting stations operating with powers of 100 W or greater in the frequency band 525-1705 kHz. For powers of less than 100 W, refer to ~~S~~section 2.11~~2.10~~.

All necessary forms are available on the Forms webpage of the Spectrum Management and Telecommunications website.

2.1.1 Online ~~A~~application ~~R~~requirements

~~To submit an application to the Department **online**, the applicant shall use the Spectrum Management System website.~~The applicant is strongly encouraged to submit an application online through ISED's Spectrum Management System, unless changes are required to a pending application or there are other special circumstances. The online system simplifies application submissions for clients since it allows for the retrieval of existing station data from the ISED database for review and modification. The online validation also minimizes delays as it reduces the possibility for errors or omissions.

The following documentation shall be attached to the application:

- an engineering brief (in PDF format), including any required maps prepared in accordance with BPR-1; and
- electronic contours (MapInfo format: *.dat/*.id/*.map/*.tab or GIS format: *.mif,*.mid) as per

~~S~~section 2.4.9~~2.4.9~~.

2.1.2 Email a~~A~~pplication ~~R~~requirements in special circumstances

When a situation may prevent an application from being submitted online, the applicant may submit the application by email to broadcasting-radiodiffusion@ised-isde.gc.ca.~~To submit an application to the Department via **email**, the applicant shall use the following address: IC.broadcasting-radiodiffusion.IC@canada.ca.~~

In addition to the documentation required for online submission, the following shall be included:

- form ISED-ISDE3050, Application for a Broadcasting Certificate for a Regular Power Undertaking (in PDF format) ~~IC-3050, Application for a Broadcasting Certificate for a Regular Power Undertaking (in PDF format)~~; ~~and~~
- form ISED-ISDE~~IC~~ 2430, Radiocommunication and Broadcasting Antenna Systems Attestation (in PDF format); and
- ~~, as applicable,~~ a copy of the Letter of Intent to the land-use authority as described in section 2 of BPR-1, ~~s~~~~Section 2~~if applicable.

It is the applicant's responsibility to ensure that all electronic documents submitted have the necessary signatures.

ISED~~The Department~~ reserves the right to request a signed attestation to verify the authenticity of an application and may hold the processing of the application until a satisfactory attestation has been received.

~~**2.1.3 Written Application Requirements**~~

~~When submitting an application on **paper**, printed and signed versions of the application form and other documentation previously described in sections 2.1.1 and 2.1.2 shall be provided.~~

~~2.1.4~~2.1.3 Other r~~R~~equirements

All proposed antenna structures whether new or modified, low or full power, must comply with the requirements of Client Procedures Circular CPC-2-0-03, *Radiocommunication and Broadcasting Antenna Systems*, and s~~S~~ection 2 of BPR-1.

In addition to meeting the requirements for on-site sharing, land-use consultation and public consultation, applicants must also fulfill other important obligations, including:

- compliance with Health Canada's Safety Code 6 – *Limits of Human Exposure to Radiofrequency Electromagnetic Energy in the Frequency Range from 3 kHz to 300 GHz (2015)* guideline for the protection of the general public,
- compliance with radio frequency immunity criteria,
- notification of nearby broadcasting stations,

- environmental considerations, and
- Transport Canada/NAV CANADA aeronautical safety responsibilities.

2.2 Definitions

Allotment Area: Specifically defined geographical area within a country, to which one or more channels are allocated, as indicated in the Allotment Plan of *Rio 1988* (Annex 4)[2]. For protection criteria, see Chapter 4 of Annex 2, *Canada/USA Agreement, 1984*.

AM Broadcasting Channel: A part of the frequency spectrum, equal to the necessary bandwidth of AM sound broadcasting stations, and characterized by the nominal value of the carrier frequency located at its centre.

Critical Hours: For stations in the band 535-1605 kHz, critical hours are defined in Article VIII of the *Canada/USA Agreement, 1984*.

For stations in the band 1605-1705 kHz, critical hours are defined as the first hour after sunrise and first hour preceding sunset at a point half way between a station producing interference and the one experiencing it.

Daytime Operation: Operation between the times of local sunrise and local sunset.

Groundwave: Electromagnetic wave which is propagated along the surface of the earth or near it and which has not been reflected by the ionosphere.

Nighttime Operation: Operation between the times of local sunset and local sunrise.

Nominal Usable Field Strength (E_{nom}): Agreed minimum value of the field strength required to provide satisfactory reception, under specified conditions, in the presence of atmospheric noise, man-made noise and interference from other transmitters. E_{nom} has been employed as the reference for planning (see Annex 2, Chapter 4 of *Canada/USA Agreement, 1984* and Annex 1, Chapter 3 of the draft *Canada/USA Agreement, 1990*).

Objectionable Interference: Interference caused by a signal exceeding the maximum permissible field strength within the protected contour or the allotment area.

Primary Service Area (525-1605 kHz): Service area delimited by the contour within which the calculated level of the groundwave field strength is protected from objectionable interference in accordance with the provisions of Annex 2, Chapter 4 of *Canada/USA Agreement, 1984*.

Protected Contour: Continuous line that delimits the area of primary or secondary service which is protected from objectionable interference.

Secondary Service Area (Applies to Class A Stations Only): Service area delimited by the contour within which the calculated level of the field strength due to the skywave field strength 50% of the time is

[2] ~~For protection criteria, see Chapter 4 of Annex 2, *Canada/USA Agreement, 1984*.~~

protected from objectionable interference in accordance with the provisions of Annex 2, Chapter 4 of *Canada/USA Agreement, 1984*.

Skywave: Electromagnetic wave which has been reflected by the ionosphere.

Usable Field Strength (E_u): Minimum value of the field strength required to provide satisfactory reception under specified conditions in the presence of atmospheric noise, man-made noise, and interference in a real situation (or resulting from a frequency assignment plan).

2.3 Classification

This section provides information on the different classes of stations.

Note: For information on protection against interference for Class A, Class B and Class C stations, see Annex 2, Chapter 4, *Canada/USA Agreement, 1984*.

Class A Station: A Class A station is intended to provide coverage over extensive primary and secondary service areas, and is protected against interference accordingly.

The maximum power of a Class A station shall be 50 kW.
The minimum power of a Class A station shall be 10 kW.

Class B Station: A Class B station is intended to provide coverage over one or more population centres and the contiguous rural areas located in their primary service area, and which is protected against interference accordingly.

The maximum power of a Class B station shall be 50 kW.
The minimum power of a Class B station shall be 250 W.

Class C Station: A Class C station is intended to provide coverage over a city or town and the contiguous suburban areas located in its primary service area, and which is protected against interference accordingly.

The maximum power of a Class C station shall be 1 kW.
The minimum power of a Class C station shall be 100 W.

Low-Power Station: A low-power station is intended to provide coverage over a town or village and the immediate contiguous area. It is not protected against interference from Class A, B or C stations and shall take remedial action if it causes interference to such stations.

The power of a low-power station shall be less than 100 W.

Carrier Current Station: A carrier current station is intended to provide service within a given property, normally by feeding the RF signal into a power line or leaky cable. It is not protected against interference from Class A, B, C or low-power stations and shall take remedial action if it causes interference to such stations.

Stations in the Band 1605-1705 kHz: Classes are not designated for stations in this band, although the

coverage is expected to be comparable to that of a Class C station. The maximum power is 10 kW.

2.4 Engineering ~~B~~brief ~~R~~requirements

The engineering brief should include the following list of sections and subsections with required details. The order should be maintained to facilitate processing by ISED~~the Department~~.

2.4.1 Title ~~P~~page

The title page should include submission title, project or reference number, date, name of applicant, applicant account number, name of consultant and principal service area (including province).

2.4.2 Summary ~~S~~sheet

A summary sheet should be included with the information in Annex D.

2.4.3 Main ~~S~~section

This section outlines the requirements for the main section of the engineering brief.

2.4.3.1 Introduction

In the introduction, include a general statement of the purpose for the brief in relation to the application.

2.4.3.2 Discussion

Include a discussion of the design considerations to accomplish the applicant's objectives, including the choice of frequency and location of site, with particular reference to interference limitations which may be received and caused by the proposed operation. Statements shall also be included with reference to the following:

(a) minimum field strength for metropolitan areas (in compliance with s~~S~~ection 3.3~~3.3~~);

(b) maximum field strength and broadcaster's responsibilities (in compliance with s~~S~~ection ~~3.10~~3.10);

(c) daytime rural service (a minimum of 0.5 mV/m to be provided); and

(d) nighttime service (Eu).

2.4.3.3 Assumptions and ~~S~~sources of ~~I~~information

List and explain all assumptions made regarding conductivity, existing limitations, and combination of interference signals, etc. Also, list the sources of information, any equation not listed or referred to in the *Canada/USA Agreement, 1984*, maps, directional antenna patterns of other stations, etc.

2.4.3.4 Transmitter

The intent to use a type-approved transmitter(s) in accordance with Broadcasting Equipment Technical Standard BETS-5, *Technical Standards and Requirements for AM Broadcasting Transmitters*, shall be

made clear, either by specifying the make, model and type-approval number, or by including a statement that the transmitter will be type-approved prior to on-air operation. The rated power of the transmitter shall be specified.

~~2.4.3.4~~2.4.3.5 Groundwave ~~I~~interference ~~A~~analysis

In a later section of the brief, a general analysis and summary of the detailed study must be provided. In Annex A, the sample sheet shows the information required for the detailed study.

~~2.4.3.5~~2.4.3.6 Skywave ~~I~~interference ~~A~~analysis

In a later section of the brief, a general analysis and summary of the detailed study must be provided. In Annex B, the sample sheet shows the information required for the detailed study.

~~2.4.3.6~~2.4.3.7 Image ~~I~~interference

If it is not possible to meet the criteria on ~~i~~Image ~~i~~Interference (~~s~~Section ~~3.9~~3.9), the following additional information is required in support of an exception:

(a) justification for selection of the frequency proposed;

(b) map showing the area of overlap of the pertinent contours of both stations;

(c) estimate of the number of broadcast receivers within the area of overlap;

(d) commitment that the applicant will investigate complaints of image interference and assume full financial responsibility for appropriate remedial measures.

~~2.4.3.7~~2.4.3.8 Intermodulation/Cross-modulation ~~I~~interference

Include statements regarding the possibility of interference due to intermodulation/cross-modulation between broadcasting stations in the area and the remedial measures to be taken should such interference result. (Refer to ~~s~~Section ~~3.11~~3.11.)

~~2.4.3.8~~2.4.3.9 Other ~~S~~significant ~~I~~information

Other technical information pertinent to the proposal should be included in this section. For example, there shall be a statement that the transmitter has been or will be type-approved and whether Modulation Dependent Carrier Level (MDCL) control will be utilized. General comments should also be made respecting audio feed, rebroadcasting operations, etc.

~~2.4.3.9~~2.4.3.10 Qualification of ~~E~~engineers

This section shall contain a listing of names and signatures of those responsible for the preparation of engineering brief. It is important to note that one signature at least, shall be that of an engineer with considerable experience in the AM broadcasting field, whose engineering stamp and signature should also appear in this section and on all coverage maps.

2.4.4 Description of ~~A~~antenna ~~S~~system and ~~A~~array

Forms listed in the *Canada/USA Agreement, 1984*, Annex 1, Parts I to V shall be completed as applicable. The format used is not important, but the data should be provided clearly and in the order shown in the agreement to minimize the risk of data error. Additional information shall be given on the type of each element of the array (i.e. guyed or self-supporting, triangular or square, uniform cross-section or tapered, etc.).

It will also be acceptable to provide the description of the antenna system and array in the ITU T04 electronic format for MF Sound Broadcasting service in Region 2 governed by the *RJ81* agreement. Additional information is provided in Annex C.

2.4.5 ~~Horizontal~~Azimuth ~~F~~field ~~S~~strength ~~P~~patterns

The methods to be used in calculating the directional antenna pattern, the expanded pattern and the modified pattern are detailed in Annex 2, Appendix 3, of the *Canada/USA Agreement, 1984*. The Annex 2 also includes criteria for reduced design tolerance. The plot of the azimuth~~horizontal~~ field strength pattern for each power or pattern involved should show:

(a) the unattenuated directional field strength at 1 km of the expanded or modified pattern as applicable and the equivalent unattenuated non-directional R~~r~~oot-M~~m~~ean-S~~s~~quare (RMS~~r.m.s.~~) field strength of the theoretical pattern at 1 km;

(b) the true north at zero azimuth;

(c) the direction to each existing station, with which interference may be involved.

Information concerning any variations from the normal practice, used in computing the above patterns shall be included such as:

(a) formulae used for calculating both azimuth~~horizontal~~ and elevation~~vertical~~ patterns and sample calculations and their derivation;

(b) assumptions made (with justification), including electrical height, current distribution and efficiency of each element and ground conductivities.

The following guidelines shall be used in plotting field strength patterns:

(a) the expanded or modified patterns as defined in the *Canada/USA Agreement, 1984*, Annex 2, Appendix 3 shall be plotted in ~~on standard letter size~~ polar coordinate~~s paper with adequate margin~~;

~~(b) all patterns shall be plotted to the largest scale possible on the paper specified in (a);~~

(b~~c~~) all values of field strength less than 10% of the RMS~~r.m.s.~~ field strength of the pattern shall be shown on an enlarged scale.

2.4.6 Plot ~~P~~plan of ~~S~~station ~~P~~property ~~S~~showing ~~L~~location of ~~T~~tower(s) and ~~G~~ground ~~S~~system

Information is required as follows on one page~~standard letter size sheet~~ in the brief:

(a) a plot plan of suitable scale showing the location of the antenna tower(s) and the limits of the

ground system; also, the location of other nearby metallic structures (refer to BPR-1, sSection 2.1);

(b) a map of scale 1:50 000 on which the antenna site is shown with the latitude and longitude of the centre of the antenna system to the nearest second (refer to BPR-1, sSection 3.1).

If a site has not been selected at the time of application, a tentative site may be submitted with the understanding that applications for departmental approval of the final site, when selected, shall be made in a separate submission at a later date.

When the proposed site is submitted for approval, applicants are cautioned that an option should be obtained on the selected property before submitting the information to the DepartmentISED.

2.4.7 Discussion of Ffactors Tthat Ccould Ddistort the Iintended Aantenna Ppatterns

If, for any reason, the calculated horizontalazimuth radiation pattern or characteristic elevationvertical patterns are unlikely to be realized unless extraordinary measures are taken, a detailed analysis of the abnormality shall be included in the engineering brief. Include a statement regarding corrective measures which might be undertaken to attempt to achieve the intended shape of the pattern.

2.4.8 Interference Aanalyses

This section outlines the procedure to be followed in conducting interference analyses for both groundwave and skywave modes of propagation.

2.4.8.1 Groundwave Iinterference Aanalyses (Dday and Nnight)

Groundwave interference analyses are to be prepared according to the sample sheet of Annex A. Details such as protection rules, ground conductivity curves and methods of calculation are found in Section 3.2 and also in Annex 2, Chapter 2 of *Canada/USA Agreement, 1984*.

Analyses of nighttime interference to the groundwave service area from adjacent channel stations are to be prepared in accordance with section 3.5.

In groundwave analyses, where radiation in a particular sector is approaching the value required to protect another assignment, the clearance shall be confirmed over an arc. This necessitates a groundwave study on a number of bearings from the stations involved. For each of these cases, the protected points should be identified by geographical coordinates or in a separate map segment. On this map, the protected and interfering contours should be drawn to demonstrate the expected clearance.

Note: The DepartmentISED will make assignment information available, including the location of protected field strength contours of Canadian stations from proofs of performance in departmental records.

2.4.8.2 Skywave Iinterference Aanalyses

Skywave interference analyses are to be prepared according to the sample sheet of Annex B. Details such as protection rules, skywave curves and method of calculating are found in Annex 2, Chapter 4, of

Canada/USA Agreement, 1984, for stations in the band 535-1605 kHz and in Annex 1, Chapter 2 of the draft *Canada/USA Agreement, 1990* for stations in the band 1605-1705 kHz (also note sSection 3.43.4).

2.4.8.3 Calculation of Ddistance and Aazimuth

All calculations of distance and azimuth are to be based on the short great-circle path assuming a spherical earth of radius 6 370 km (one degree on the surface of the earth equals 111.18 km).

2.4.9 Maps Sshowing Ppertinent Ffield Sstrength Ccontours

The following field strength contours shall be plotted for each radiation pattern proposed (i.e., if powers or patterns are different day and night), on up-to-date maps (refer to sSection 3 of BPR-1):

1 000, 250, 25, 15, 5, 0.5 mV/m, E_u and if within 0.5 mV/m contour, the contour which is 20% of E_u.

For stations in the band 1605-1705 kHz, the night E_u should be assumed to be E_{nom} unless the effect of existing or proposed stations would make it higher.

Maps are required for the following proposed service coverage contours:

(a) For daytime: one map showing the 25 mV/m, 15 mV/m, 5 mV/m and 0.5 mV/m contours;

(b) For nighttime: one map showing the usable field strength (E_u) contour, and if enclosed within the E_u, the 25 mV/m and the 5 mV/m nighttime contour(s);

(c) For daytime: one map showing the 1 000 mV/m and 250 mV/m contours.

Each map should be clearly labelled as to whether it applies to day or night operation.

For changes of facilities, a map shall be provided showing both the authorized and the proposed 0.5 mV/m and E_u contours.

If satisfactory precision cannot be achieved on a single map, separate maps should be used.

2.4.10 Additional Rrequirements

When the proposal involves the acceptance of objectionable interference as defined in both agreements, such areas shall be shown by cross-hatched areas on coverage maps.

2.4.11 Commitments

The commitments relating to the resolution of any potential interference problems, as required in the above sections, shall be included:

(a) Image interference (sSection 2.4.3.62.4.3.7 and sSection 3.9.23.9.2).

(b) Intermodulation and cross-modulation (sSection 3.113.11).

(c) Maintenance of reduced tolerance directional patterns (sSection 2.4.5 and Annex 2, Appendix

3, Attachment B of *Canada/USA Agreement, 1984*).

(d) Any commitment made in reaching an agreement with another station, particularly in relation to "lock-in" (~~s~~Section ~~3.8.2~~3.8.2) and departures from normal protection requirements (~~S~~section 3.12~~3.12~~).

These commitments are related to specific potential problems and complement the general commitment in the application forms.

2.5 Final ~~P~~proof of ~~P~~performance for ~~D~~directional ~~A~~antennas

An installation is deemed to be incomplete until the ~~F~~final ~~P~~proof of ~~P~~performance of the directional antenna system has been submitted to the Director, Broadcast, Coordination and Planning~~, Broadcast Applications Engineering~~, and approved by ISED~~Innovation, Science and Economic Development Canada~~.

2.5.1 Documentation

When a station proposes to operate with a directional antenna either full- or part-time, it is necessary that proof be submitted that the pattern produced by the antenna array agrees with the pattern predicted and approved for that station, both as to shape and size within an acceptable tolerance. It is also necessary that proof be submitted as to the actual performance of the radiating elements, including impedance characteristics and radiation efficiency.

Field strength contours are required to show the actual coverage of the station, although the contour protected against interference from other stations is that calculated, in accordance with Annex 2, Chapter 2 of *Canada/USA Agreement, 1984* and for stations in the band 1605-1705 kHz, with ~~S~~section ~~3.6~~3.6, unless there is specific agreement between the stations involved.

The data outlined in sections 2.5.3, 2.5.4 and 2.5.5~~2.5.3, 2.5.4 and 2.5.5~~ shall be submitted in the proof of performance, together with a description of the procedure to be followed in obtaining this data.

2.5.2 Tolerance

The normal upper limit is the expanded pattern and the normal lower limit is 5% below the theoretical pattern. Any deviation beyond these limits should be justified. Also, if the upper limit is exceeded but this would not lead to interference, the pattern may be modified in accordance with Annex 2, Appendix 3 of *Canada/USA Agreement, 1984*. The upper limit may not be exceeded if interference would result.

2.5.3 Field ~~S~~strength ~~M~~measurements to ~~E~~establish ~~E~~effective ~~F~~field ~~S~~strength at 1 km

Beginning as near to the antenna as possible without including the induction field and to provide for the fact that a broadcast antenna is not a point source of radiation, measurements shall be made on eight or more radials, at intervals of approximately:

- 200 metres up to 3 km from the antenna;
- 1 kilometre from 3 to 10 km from the antenna; and

- 3 kilometres beyond 10 km, as required.

Where unobstructed measurements can be made, there should be 18 or more on each radial. However, where unobstructed measurements are difficult to make, these shall be made on each radial at as many unobstructed locations as possible, even though the intervals are considerably less than stated above, particularly within 5 km of the antenna.

In cases where it is not possible to obtain accurate measurements at the closer distances (even out to 8 or 10 km due to the character of the intervening terrain), measurements at greater distances should be made at closer intervals.

The measurement data shall be plotted for each radial using log-log coordinates ~~paper~~, with field strength as ordinate and distance as abscissa.

The appropriate ~~-~~curve to be drawn through the points plotted shall be determined by comparison with theoretical curves as follows:

- plot theoretical curves (refer to Annex 2, Appendix 2 of the *Canada/USA Agreement, 1984* and Annex 1, Chapter 2 of the *Rio 1988* agreement) for several values of conductivities approximating the conductivity indicated by the measurements on another graph~~sheet~~ of the same coordinates ~~paper~~;

- overlay this ~~place this sheet under the sheet on which~~graph on the actual points that have been plotted and adjust until the curve most closely matching the points is found;

- draw this curve ~~on the sheet on which~~with the points that were plotted, together with the inverse distance curve corresponding to that curve.

The field at 1 km for the radial concerned shall be the ordinate on the inverse distance curve at 1 km.

When all radials have been analyzed in this manner, a curve shall be plotted using~~on~~ polar coordinates ~~paper~~ from the inverse distance field strengths obtained, which give the inverse distance field pattern at 1 km. The radius of a circle, the area of which is equal to the area bounded by this pattern, is the effective field.

While making the field strength measurement, the MDCL control shall be turned off (if applicable) and the output power of the station should be maintained at the licensed power as determined by the direct method. If a lower power is used, the measured results should be adjusted appropriately. Therefore, it is necessary to determine the antenna impedances as accurately as practical and to measure the antenna current by means of an ammeter of known accuracy.

Complete data taken in conjunction with the field strength measurements shall be submitted, including the following:

(a) tabulation by number of each point of measurement, the field strength and the distance from the antenna;

(b) map(s) showing each point of measurement numbered to agree with the tabulation required in (a) above;

(c) curves drawn for each radial showing the field strength as a function of distance;

(d) antenna self impedances (Z = R + jX) for each tower measured at carrier frequency and in 10 kHz steps over the range ±30 kHz, and the results presented in tabular as well as graphical forms;

(e) antenna operating impedances (Z = R + jX) for each tower and for the day and/or night pattern at carrier frequency;

(f) antenna current or currents maintained during field strength measurements; and

(g) any other pertinent information.

2.5.4 ~~F~~Field ~~S~~strength ~~M~~measurements to ~~E~~establish ~~P~~performance of ~~D~~directional ~~A~~antennas

To establish this performance, measurements shall be made in accordance with the preceding ~~s~~Section ~~2.5.3~~2.5.3 along a sufficient number of radials to establish the effective field from the antenna system. In the case of a relatively simple directional antenna pattern, approximately eight radials in addition to the radials in the directions of limitation are sufficient. However, when more complicated patterns are involved, i.e., patterns having several sharp lobes or nulls, measurements shall be taken along as many additional radials as necessary to establish the pattern.

It may be necessary to make ratio measurements, as described in ~~S~~section ~~2.9.2~~2.10.2, to better define the pattern between radials.

The information described in sections ~~2.5.4.1~~2.5.4.1 to ~~2.5.4.5~~2.5.4.5 shall be submitted.

2.5.4.1 Antenna ~~A~~array ~~D~~description

A description of the antenna array must outline the following:

(a) number of elements;

(b) type of each element (i.e., guyed or self-supporting, triangular or square, uniform cross-section or tapered, etc.);

(c) if top-loaded, pertinent details;

(d) overall height (in metres) of each element above ground level;

(e) orientation of each element with respect to true north from a reference point in the array;

(f) space phasing of elements (space phasing should be given in metres as well as in degrees);

(g) details of ground system for each element (length and number of radials, dimensions of ground screen if used, and depth buried);

(h) current in each element (at point where antenna ammeter is located) and current and impedance at point of common input to the antenna system;

(i) phase readings (specifying whether leading or lagging) and the relative current readings for each element.

2.5.4.2 ~~Horizontal~~Azimuth ~~F~~f**ield** ~~S~~s**trength** ~~P~~p**atterns**

~~Horizontal~~Azimuth field strength patterns must be provided for each power involved showing:

- directional field strength at 1 km and effective field strength from the antenna determined from the field strength calculations. Show these points on the expanded (or modified, if applicable) pattern;
- true north at zero azimuth.

2.5.4.3 Contour ~~M~~m**aps**

Contour maps shall include:

- the measured field strength contour maps in the same format as in ~~S~~section ~~2.4.9~~2.4.9; and
- the tabulation of all data used in plotting the above contours.

2.5.4.4 Plotting of ~~F~~f**ield** ~~S~~s**trength** ~~P~~p**atterns**

For information on plotting field strength patterns refer to ~~S~~section ~~2.4.5~~2.4.5.

2.5.4.5 Other ~~I~~i**nformation**

Any other pertinent information must be provided.

2.5.5 Test ~~E~~e**quipment and** ~~Q~~q**ualifications**

The following information shall be submitted on the equipment used for the measurements and on the qualifications of the person responsible for the measurements:

- description, accuracy, date and by whom each instrument was last calibrated;
- name, stamp and signature of the engineer responsible for the measurements.

2.6 Preliminary ~~P~~p**roof of** ~~P~~p**erformance for** ~~D~~d**irectional** ~~A~~a**ntennas**

It is recognized that the surveys and calculations necessary for a ~~F~~final ~~P~~proof of ~~P~~performance may take considerable time. For this reason, ~~the Department~~ISED will normally accept a ~~P~~preliminary ~~P~~proof of ~~P~~performance for the purpose only of permitting the station to commence operation, provided the ~~F~~final ~~P~~proof of ~~P~~performance is submitted within 120 days.

2.6.1 Documentation

The p~~P~~reliminary ~~P~~proof of ~~P~~performance shall be submitted to the Director, Broadcast, Coordination and Planning ~~Applications Engineering~~ before starting on-air testing as specified in ~~S~~section 1.4 of BPR-1. It shall consist of the following:

(a) proof of the shape of the pattern determined from field strength measurements taken at a convenient distance (close to the array but beyond the near field) from the transmitter at approximately 15° intervals, by means of ratio between the directional pattern and non-directional operation, or by any other acceptable method such as short radials if a reliable non-directional pattern is not available;

(b) proof of the size of the pattern by means of a series of readings along one radial in a major lobe to a distance of at least 16 km. The approximate effective field at 1 km, the attenuation curve and the mean conductivity for the region, shall be determined from these readings;

(c) antenna operating impedances (Z = R + jX) for each tower and pattern at carrier frequency and the antenna self-impedances for each tower measured at carrier frequency and in 10 kHz steps over the range of ±30 kHz.

Where protection to other stations on the same or adjacent channels is required, additional measurements shall be supplied to show that interference will not result from the operation of the station for which the proof of performance is being made.

2.6.2 Tolerance

The normal upper limit is the expanded pattern and the normal lower limit is 5% below the theoretical pattern. Any deviation beyond these limits should be justified. Also, if the upper limit is exceeded but this would not lead to interference, the pattern may be modified in accordance with Annex 2, Appendix 3 of *Canada/USA Agreement, 1984*. The upper limit may not be exceeded if interference would result.

2.7 Directional antenna proof of performance with computer modeling

This section outlines the procedures to be followed in preparing and submitting technical information required in support of an application using computer modeling and sample system verification of modeled parameters to establish the operation of a directional antenna consistent with the theoretical pattern.

Each element of the directional array shall be modeled by use of a method of moments computer program, using the physical characteristics of each element to establish a model that does not violate any of the internal constraints of the computer program. Only arrays consisting of series-fed elements may have their performance verified by computer modeling and sample system verification.

2.7.1 Computer modeling parameters and constraints

A matrix of impedance measurements at the base and/or feed point of each element in the array, with all other elements shorted or open circuited at their respective measurement locations, shall be made. The physical model of the individual antenna elements used in the computer program may be varied to match the measured impedance matrix, but the actual spacings and orientations of the array elements

must be maintained. Towers may be modeled using individual vertical wires to represent them, or with multiple wires representing their leg and cross-member sections.

The resulting model description (consisting of the length, radius, and number of segments of each wire for arrays using vertical wire sections to represent the towers, or the length, end-point coordinates, and radius of each wire used to represent leg and cross-member sections for arrays using detailed tower structure representations) as well as the assumed input feed and base region stray reactances shall be used to generate the drive impedances and sample system parameter values for the operating directional antenna pattern parameters.

(a) For arrays using vertical wires to represent each tower, the radii of cylinders shall be no less than 80% and no more than 150% of the radius of a circle with a circumference equal to the sum of the widths of the tower sides.

(b) For arrays using multiple wires to represent leg and cross-member sections, the individual legs of the tower may be modeled at their actual diameters with appropriate interconnecting segments representing cross-members at regular intervals.

(c) No less than one segment for each 10 electrical degrees of the tower's physical height shall be used for each element in the array.

(d) Base calculations shall be made for a reference point at ground level or within one electrical degree elevation of the actual feed point.

(e) For uniform cross-section towers represented by vertical wires, each wire used for a given tower shall be between 75 to 125% of the physical length represented.

(f) For self-supporting towers, stepped-radius wire sections may be employed to simulate the physical tower's taper, or the tower may be modeled with individual wire sections representing the legs and cross members.

(g) The lumped series inductance of the feed system between the output port of each antenna tuning unit and the associated tower shall be no greater than 10 µH unless a measured value from the measurement point to the tower base with its insulator short circuited is used.

(h) The shunt capacitance used to model the base region effects shall be no greater than 250 pF unless the measured or manufacturer's stated capacitance for each device other than the base insulator is used. The total capacitance of such devices shall be limited such that in no case will their total capacitive reactance be less than five times the magnitude of the tower base operating impedance without their effects being considered. This “five times” requirement only applies when the total capacitance used to model base region effects exceeds 250 pF and when base current sampling is used.

(i) The orientation and distances among the individual antenna towers in the array shall be confirmed by a post-construction certification by a land surveyor (or, where permitted by local regulation, by an engineer) licensed or registered in the province or territory where the antenna system is located. Stations submitting a moment method proof for a pattern using towers that are part of an authorized AM array are exempt from the requirement to submit a surveyor's certification, provided that the tower geometry of the array is not being modified and that no

new towers are being added to the array.

(j) An AM station that verified the performance of its directional antenna system using computer modeling and sampling system verification under this section, that makes modifications to tower or system components above the base insulator, shall follow the procedures set forth in section 2.7.5.

2.7.2 Measurement and modeling requirements

This section contains the parameters and tolerances for verification of the sampling system.

2.7.2.1 Sampling system

The computer model, once verified by comparison with the measured base impedance matrix data, shall be used to determine the appropriate antenna monitor parameters. The method of moments modeled parameters shall be established by using the verified moment method model to produce tower current distributions that, when numerically integrated and normalized to the reference tower, are identical to the specified field parameters of the theoretical directional antenna pattern.

The samples used to drive the antenna monitor may be current transformers or voltage sampling devices at the outputs of the antenna matching networks or sampling loops located on the towers. If sample loops are used, they shall be located at the elevation where the current in the tower would be at a minimum if the towers were detuned in the azimuth plane, as determined by the moment method model parameters used to determine the antenna monitor parameters. Sample loops may be employed only when the towers are identical in cross-sectional structure, including both leg and cross member characteristics; if the towers are of unequal height, the sample loops shall be mounted identically with respect to tower cross members at the appropriate elevations above the base insulator. If the tower height used in the model is other than the physical height of the tower, the sampling loop shall be located at a height that is the same fraction of the total tower height as the minimum in tower current with the tower detuned in the model.

Sample lines from the sensing element to the antenna monitor must be equal in both length (within one electrical degree) and characteristic impedance (within 2 Ω). The tolerances are established by impedance measurements, including at the open-circuit resonant frequency closest to carrier frequency to establish length, at frequencies corresponding to odd multiples of 1/8 wavelength immediately above and below the open circuit resonant frequency closest to carrier frequency, while open circuited, to establish characteristic impedance, and at carrier frequency or, if necessary, at nearby frequencies where the magnitude of the measured impedance is no greater than 200 Ω with the sampling devices connected.

Samples may be obtained from current transformers at the output of the antenna coupling and matching equipment for base-fed towers whose actual electrical height is 120 degrees or less, or greater than 190 electrical degrees. Samples may be obtained from base voltage sampling devices at the output of the antenna coupling and matching equipment for base-fed towers whose actual electrical height is greater than 105 degrees. Samples obtained from sample loops located as described above can be used for any height of tower.

For towers using base current or base voltage sampling derived at the output of the antenna coupling

and matching equipment, the sampling devices shall be disconnected and calibrated by measuring their outputs with a common reference signal (a current through them or a voltage across them, as appropriate) and the calibration must agree within the manufacturer's specifications. A complete description of the sampling system, including the results of the measurements described in this paragraph, shall be submitted with the application.

2.7.2.2 Measurement and modeling parameter correlation

Proper adjustment of an antenna pattern shall be determined by correlation between the measured antenna monitor sample indications and the parameters calculated by the method of moments program, and by correlation between the measured matrix impedances for each tower and those calculated by the method of moments program. The antenna monitor sample indications must be initially adjusted to agree with the moment method model within ±5% for the field ratio and ±3° in phase. The measured matrix impedances must agree with the method of moments model within ±2 Ω and ±4% for resistance and reactance.

2.7.3 Field measurements

When the application for a directional antenna system is submitted that is based on computer modeling and sample system verification, reference field strength measurement locations shall be established in the directions of pattern minima and maxima. On each radial corresponding to a pattern minimum or maximum, there shall be at least three measurement locations. The field strength shall be measured at each reference location at the time of the proof of performance.

The certificate application shall include the measured field strength values at each reference point, along with a description of each measurement location, including GPS coordinates and datum reference.

While making the field strength measurement, the MDCL control shall be turned off (if applicable) and the output power of the station should be maintained at the authorized power as determined by the direct method. If a lower power is used, the measured results should be adjusted appropriately.

2.7.4 Documentation

The proof of performance with computer modeling shall include the following.

2.7.4.1 Antenna array description

A description of the antenna array must outline the following:

(a) number of elements;

(b) type of each element (i.e., guyed or self-supporting, triangular or square, uniform cross-section or tapered, etc.);

(c) if top-loaded, pertinent details;

(d) overall height (in metres) of each element above ground level;

(e) orientation of each element with respect to true north from a reference point in the array;

(f) space phasing of elements (space phasing should be given in metres as well as in degrees);

(g) details of ground system for each element (length and number of radials, dimensions of ground screen if used, and depth buried);

(h) current in each element (at point where antenna ammeter is located) and current and impedance at point of common input to the antenna system; and

(i) phase readings (specifying whether leading or lagging) and the relative current readings for each element.

2.7.4.2 Modeling and measurement data

The proof of performance with computer modeling shall include the following:

(a) tabulation by number of each point of measurement, the field strength and the distance from the antenna;

(b) map(s) showing each point of measurement numbered to agree with the tabulation required in (a) above;

(c) antenna self impedances ($Z = R \pm jX$) for each tower measured at carrier frequency and in 10 kHz steps over the range ±30 kHz, and the results presented in tabular as well as graphical forms;

(d) antenna self impedances ($Z = R \pm jX$) for each tower measured at carrier frequency that are correlated with computer modeling data including stray reactances, and the results presented in tabular form;

(e) antenna operating impedances ($Z = R \pm jX$) for each tower measured at carrier frequency correlated with computer modeling data including stray reactances, and the results presented in tabular form;

(f) measured antenna monitor sample indications correlated with the parameters calculated by the method of moments field ratios for each tower at carrier frequency, and the results presented in tabular form;

(g) measured sample lines electrical length and characteristic impedances at carrier frequency, and the results presented in tabular form;

(h) antenna RMS current for each tower; and

(i) any other pertinent information.

2.7.4.3 Test equipment and qualifications

The following information shall be submitted on the equipment used for the measurements and on the qualifications of the person responsible for the measurements:

- description, accuracy, date and by whom each instrument was last calibrated; and
- name, stamp and signature of the engineer responsible for the measurements.

2.7.5 Installations on an AM antenna

For AM stations authorized by a proof of performance utilizing the moment method, a base impedance measurement on the tower being modified shall be made by the tower proponent as described in section 2.7.1. The result of the new tower impedance measurement shall be retained in the station's records. If the new measured base resistance and reactance values of the affected tower differ by more than ±2 Ω and ±4% from the corresponding modeled resistance and reactance values contained in the last moment method proof, then the station shall file form ISED-ISDE3050, Application for a Broadcasting Certificate for a Regular Power Undertaking (in PDF format). The form ISED-ISDE3050 shall be accompanied by the new impedance measurements for the modified tower and a new moment method model for each pattern in which the tower is a radiating element. Base impedance measurements for other towers in the array, sampling system measurements, and reference field strength measurements need not be repeated. The procedures described in this paragraph may be used as long as the affected tower continues to meet the requirements for moment method proofing after the modification.

~~2.7~~2.8 Final ~~P~~proof of ~~P~~performance for ~~N~~non-~~D~~directional ~~A~~antennas

The installation is deemed to be incomplete until such time as the ~~F~~final ~~P~~proof of ~~P~~performance of the antenna system has been submitted to the Director, Broadcast, Coordination and Planning~~Applications Engineering~~, and approved by ~~the Department~~ISED.

~~2.7.1~~2.8.1 Documentation

A proof of performance demonstrating the inverse distance field strength in terms of millivolts per metre at a distance of 1 km is required of all broadcasting stations operating with non-directional antennas.

Field strength contours are required to show the actual coverage of the station, although the contour protected against interference from other stations is that calculated in accordance with Annex 2, Chapter 2 of *Canada/USA Agreement, 1984* and for stations in the band 1605-1705 kHz, with ~~S~~section ~~3.6~~3.6, unless there is specific agreement between the stations involved.

The following are the data which shall be submitted in the proof of performance, together with a description of the procedure to be followed in obtaining these data.

~~2.7.2~~2.8.2 Field ~~S~~strength ~~M~~measurements to ~~E~~establish ~~E~~effective ~~F~~field ~~S~~strength at 1 ~~K~~km for ~~C~~class A or B ~~s~~Stations

Beginning as near to the antenna as possible without including the induction field and to provide for the fact that a broadcast antenna is not a point source of radiation (not less than one wavelength or five times the vertical height), measurements shall be made on eight radials at intervals of approximately:

- 200 metres up to 3 km from the antenna;
- 1 kilometre from 3 to 10 km from the antenna; and
- 3 kilometres beyond 10 km, as required.

Where unobstructed measurements can be made, there should be 18 or more on each radial. However, where unobstructed measurements are difficult to make, these shall be made on each radial at as many unobstructed locations as possible, even though the intervals are considerably less than stated above, particularly within 5 km of the antenna. In cases where it is not possible to obtain accurate measurements at the closer distances (even out to 8 or 10 km due to the character of the intervening terrain), the measurements at greater distances should be made at closer intervals.

The measurement data shall be plotted for each radial using a log-log coordinate scale~~paper~~ with field strength as ordinate and distance as abscissa.

The appropriate curve to be drawn through the points plotted shall be determined by comparison with theoretical curves as follows:

plot theoretical curves (refer to Annex 2, Appendix 2 of the *Canada/USA Agreement, 1984* and Annex 1, Chapter 2 of the *Rio 1988* agreement) for several values of conductivities approximating the conductivity indicated by the measurements on another graph~~sheet~~ of the same coordinates ~~paper~~;

overlay~~place~~ this graph~~sheet under the sheet~~ on ~~which~~ the actual points that have been plotted and adjust until the curve most closely matching the points is found;

draw this curve ~~on the sheet on which~~with the points that were plotted, together with the inverse distance curve corresponding to that curve.

The field at 1 km for the radial concerned shall be the ordinate on the inverse distance curve at 1 km.

When all radials have been analyzed in this manner, a curve shall be plotted ~~on~~using polar coordinates ~~paper~~ from the fields obtained, which gives the inverse distance field pattern at 1 km. The radius of a circle, the area of which is equal to the area bounded by this pattern, is the measured effective field.

While making the field strength survey, the MDCL control shall be turned off (if applicable) and the output power of the station should be maintained at the licensed power as determined by the direct method. If a lower power is used, the results of measurements should be adjusted appropriately. Therefore, it is necessary to determine the antenna impedance as accurately as practical and to measure the antenna current by means of an ammeter of known accuracy.

Complete data taken in conjunction with the field strength measurements shall be submitted, including:

(a) tabulation by number of each point of measurement, the field strength and the distance from the antenna for each point of measurement;

(b) map(s) showing each point of measurement numbered to agree with the tabulation required in (a) above;

(c) curves drawn for each radial showing the field strength as a function of distance;

(d) antenna self impedance ($Z = R + jX$) at carrier frequency and in 10 kHz steps over the range ±30 kHz, and the results presented in tabular as well as graphical forms;

(e) antenna current (day and night) maintained during field strength measurements;

(f) any other pertinent information.

~~2.7.3~~2.8.3 Field ~~S~~strength ~~M~~measurements to ~~E~~establish ~~E~~effective ~~F~~field ~~S~~strength at 1 km for ~~C~~class C ~~S~~stations

The procedure for establishing the effective field strength at 1 km for Class C stations or stations in the band 1605-1705 kHz, shall be the same as in ~~S~~section ~~2.7.2~~2.8.2 above except that measurements may be made on two radials only, and need not extend beyond the 0.5 mV/m contour.

~~2.7.4~~2.8.4 Test ~~E~~equipment and ~~Q~~qualifications

The following information shall be submitted on the equipment used for the measurements and on the qualifications of the person responsible for the measurements:

(a) description, accuracy, date and by whom each instrument was last calibrated;

(b) name, stamp and signature of the engineer responsible for the measurements.

~~2.7.5~~2.8.5 Plot of ~~F~~field ~~S~~strength

The measured field strength contours should be presented in the same format as in ~~S~~section ~~2.4.9~~2.4.9.

~~2.8~~2.9 Preliminary ~~P~~proof of ~~P~~performance for ~~N~~non-~~D~~directional ~~A~~antennas

The surveys and calculations necessary for a ~~F~~final ~~P~~proof of ~~P~~performance may take considerable time. ~~The Department~~ISED will normally accept a ~~P~~preliminary ~~P~~proof of ~~P~~performance for the purpose only of permitting the station to commence operation, provided that the ~~F~~final ~~P~~proof of ~~P~~performance is submitted within 120 days.

~~2.8.1~~2.9.1 Documentation

The ~~P~~preliminary ~~P~~proof of ~~P~~performance shall be submitted to the Director, Broadcast, Coordination and Planning~~Applications Engineering~~, before commencement of on-air testing as specified in ~~S~~section 1.4 of BPR-1 and shall consist of:

(a) a tabulation by number (at least 10) of each point of measurement of the field strength taken along one radial to establish with reasonable accuracy the inverse distance field strength in mV/m at 1 km;

(b) distances from the antenna of all measurement points included in the tabulation required in (a) above;

(c) a plot of the measurements as required in ~~S~~section ~~2.7.2~~2.8.2 with the unattenuated field at 1 km as indicated.

Where protection to other stations on the same or adjacent channels is required, additional measurements shall be supplied to show that interference will not result from the operation of the station for which the proof of performance is being made.

~~2.9~~2.10 Supplementary ~~P~~proof of ~~P~~performance

This section outlines the procedure to be followed in preparing and submitting technical information required in support of a supplementary proof of performance application.

~~2.9.1~~2.10.1 Introduction

Broadcasting undertakings must be constructed, operated and maintained in accordance with authorized parameters, the *Broadcasting Procedures and Rules* and broadcasting equipment standards, as well as Canadian and international radio regulations. Accordingly, a Supplementary Proof of Performance (SPOP) shall be submitted, upon request by ISED~~the Department~~, to demonstrate that the broadcast undertaking continues to function as authorized. SPOPs are not required for stations that have non-directional antenna systems.

In addition to normal monitoring, the following comprise the requirements for an SPOP to demonstrate that the broadcast antenna system continues to function as authorized.

An SPOP shall be completed following the procedure in this section or by computer modeling as specified in section 2.7.

~~2.9.2~~2.10.2 Measurements

The shape of the directional pattern shall be determined from field strength measurements taken at a convenient distance from the transmitter at approximately 15 degree intervals by means of the ratio between the directional pattern and non-directional operation, or by any other acceptable method such as short radials if a reliable non-directional pattern is not available.

The following describes the ratio method procedure:

(a) measure and calculate the ratio of the directional (D) and non-directional (ND) E-fields, giving the following results for each azimuth:

D/ND ratio = E_D/E_{ND}

where E_D = directional E-field at authorized power (P_D)

E_{ND} = non-directional E-field at known power (P_{ND})

(b) determine the effective (unattenuated) non-directional field at 1 km ($E_{ND@1km}$) at the known power using radial measurements;

(c) if the directional and non-directional powers are not equal during the field ratio measurements, then the effective non-directional field must be corrected by using the following formula:

$$F = E_{ND@1km} \times \sqrt{\frac{P_D}{P_{ND}}} mV/m$$

where:

F = corrected non-directional E-field; referred to as the "multiplication factor", since it is used to multiply all ratio points.

$E_{ND@1\ km}$ = effective non-directional E-field at 1 km at power P_{ND}.

P_D = authorized power used during the directional E-field ratio point measurements.

P_{ND} = known power used during the non-directional E-field ratio point measurements.

(d) ratio point measurements are chosen at approximately 15 degree intervals around the reference tower, close enough that conductivity effects are minimal, but far enough to avoid near-field effects, and ratio measurements are made for the directional (D) and non-directional (ND) patterns.

(e) the D/ND ratios multiplied by the "F" factor establish the antenna radiation pattern at full authorized power. The information is then plotted on a polar graph and compared with the antenna radiation pattern authorized for the undertaking.

The size of the pattern shall be determined by means of a series of field strength measurements taken in a major lobe along one radial from approximately 200 m from the antenna to a distance of 16 km or to the 0.5 mV/m contour whichever is closer. The effective unattenuated field strength at 1 km shall be determined from these readings by plotting on log-log coordinates ~~paper~~ the field strength measurements as ordinate and distance as abscissa. The appropriate curve to be drawn through the points plotted shall be determined by comparison with theoretical curves as follows:

(a) plot theoretical curves (refer to Appendix 2 of the *Canada/USA Agreement, 1984* and Annex 1, Chapter 2 of the *Rio 1988* agreement) for several values of conductivities approximating the conductivity indicated by the measurements on another graph~~sheet~~ of the same coordinates ~~paper~~;

(b) overlay~~place~~ this ~~sheet under the sheet~~ graph on ~~which~~ the actual data points that have been plotted and adjust until the curve most nearly matching the points is found;

(c) draw this curve on the graph~~sheet~~ on which the points were plotted.

The field at 1 km for the radial shall be the ordinate on the inverse distance curve at 1 km.

Impedance characteristics of the radiating elements and the operating impedance at point of common input shall be determined by the direct method and expressed as Z = R + jX.

While making the field strength measurements, the MDCL control shall be turned off (if applicable) and the output power of the station should be maintained at the licensed power as determined by the direct method. A careful log shall be taken of the operating parameters during the measurement period.

~~2.9.3~~2.10.3 Documents

A S~~U~~POP~~upplementary Proof of Performance~~ shall comprise the following, prepared or approved by a professional engineer and submitted over the engineer's stamp and signature:

(a) A statement of the work which was done, adjustments made, components replaced, measurements taken and instructions left with operating staff;

(b) A polar plot of the measured pattern and the expanded (or modified, if applicable) directional

antenna pattern (see ~~S~~section ~~2.4.5~~2.4.5 for guidelines);

(c) A plot of the field strength measurements made along the single radial, together with the inverse distance curve plotted on a suitable log-log graph ~~paper~~. The values of ground conductivity and field strength at 1 km shall be marked;

(d) Information on the antenna impedance measurements showing:

- description of the methods employed;
- measurement data;
- impedances of each tower at the operating frequency expressed as Z = R + jX;

(e) A table of current and phase readings of the transmitter and antenna system as finally adjusted and the transmitter output efficiency;

(f) If other work was done at the transmitter, such as adjustment and calibration of supervisory control equipment, frequency or modulation monitors, proper documentation covering this work should also be included.

~~2.9.4~~2.10.4 Tolerance

The normal upper limit is the expanded pattern and the normal lower limit is 5% below the theoretical pattern. Any deviation beyond these limits should be justified. Also if the upper limit is exceeded but this would not lead to interference, the pattern may be modified in accordance with Annex 2, Appendix 3 of Canada/USA Agreement, 1984. The upper limit may not be exceeded if interference would result.

~~2.9.5~~2.10.5 Test ~~E~~equipment and ~~Q~~qualifications

The following information shall be submitted on the equipment used for the measurements and on the qualifications of the person responsible for the measurements:

(a) description, accuracy, date and by whom each instrument was last calibrated;

(b) name, stamp and signature of the engineer responsible for the measurements.

~~2.10~~2.11 Applications for ~~L~~low-~~P~~power ~~U~~unprotected ~~S~~stations and ~~C~~carrier ~~C~~current ~~S~~systems ~~W~~with ~~T~~transmitter ~~P~~powers of ~~L~~less ~~T~~than 100 W

This section outlines the procedure to be followed in preparing and submitting technical information required in support of applications for low-power unprotected stations and carrier current systems with transmitter powers of less than 100 W.

~~2.10.1~~2.11.1 Low-~~P~~power ~~U~~unprotected ~~B~~broadcasting ~~S~~stations

Normally, an application for a low-power unprotected broadcasting station is technically acceptable if:

(a) no interference to other stations is predicted, using regular protection criteria;

(b) the signal level within the area to be served is sufficient to provide reliable daytime and nighttime services;

(c) the disparity between day and night service is minor, i.e., the E_u contour shall enclose at least 90% of the population within the 0.5 mV/m contour.

The transmitter should meet Broadcasting Equipment Technical Standard BETS-5, *Technical Standards and Requirements for AM Broadcasting Transmitters*. Use of a transmitter which does not meet these standards could result in an inadequate quality of service. If there will be an implementation of MDCL control on the transmitter, this should be clearly indicated in the application.

All necessary forms are available on the Forms webpage of the Spectrum Management and Telecommunications website.

~~2.10.1.1~~2.11.1.1 Online ~~A~~application ~~R~~requirements

The applicant is strongly encouraged to submit an application online through ISED's Spectrum Management System, unless changes are required to a pending application or there are other special circumstances. The online system simplifies application submissions for clients since it allows for the retrieval of existing station data from the ISED database for review and modification. The online validation also minimizes delays as it reduces the possibility for errors or omissions.~~To submit an application to the Department **online**, the applicant shall use the Spectrum Management System website.~~

~~The following document~~ An engineering brief (in PDF format) shall be attached to a low-power AM application.~~:~~

- ~~an engineering brief (in PDF format).~~

Normally, an engineering brief need only describe the transmitting plant and location (population to be served, audio feed). However, if ~~the Department~~ISED's analysis indicates that protection or service requirements may not have been met, a detailed engineering submission may be requested.

~~2.10.1.2~~2.11.1.2 Email ~~A~~application ~~R~~requirements in special circumstances

When a situation may prevent an application from being submitted online, the applicant may submit the application by email to broadcasting-radiodiffusion@ised-isde.gc.ca. ~~To submit an application to the Department via **email**, the applicant shall use the following address: IC.broadcasting-radiodiffusion.IC@canada.ca.~~

In addition to the documentation required for the online submission, the following shall be included:

- Form ISED-ISDE 3051, *Application for a Broadcasting Certificate for a Low-Power or Very Low-Power Undertaking* (in PDF format);
- Form ISED~~C~~-ISDE2430, *Radiocommunication and Broadcasting Antenna Systems Attestation* (in PDF format) and, as applicable, a copy of the Letter of Intent to the land-use authority as described in BPR-1, ~~S~~section 2.

~~2.10.1.3 2.10.1.3 Written Application Requirements~~

~~When submitting a written application, printed and signed versions of the application form and other documentation previously described shall be provided.~~

~~With regard to locating the antenna site, refer to Section 2.1.4.~~

~~2.10.2~~2.11.2 Carrier ~~C~~current ~~S~~systems

Normally, an application for carrier current system is considered technically acceptable if the technical requirements of ~~the Department~~ISED are met as set forth here.
The requirements are the following:

(a) An engineering brief containing the following data shall be submitted to ~~the Department~~ISED:

- location of the transmitter;
- proposed frequency; and
- type of equipment to be used (manufacturer's name, model number, power). This equipment should be approved by ISED~~Innovation, Science and Economic Development Canada~~.

(b) Such apparatus will deliver to the line network the minimum radio frequency power necessary to accomplish the desired purpose.

(c) No interference is expected to be caused to other radio services.

~~2.10.2.1~~2.11.2.1 Proof of ~~P~~performance and ~~C~~certification

A proof of performance demonstrating that the installation meets the requirements mentioned below, shall be submitted to the Director, Broadcast, Coordination and Planning~~st Applications Engineering~~, before commencement of on-air testing as specified in BPR-1, ~~S~~section 1.4.

The applicant shall provide evidence that the electromagnetic field extending outside the property to be served containing the signal distribution circuit does not exceed 15 µV/m at a distance

$$d = \frac{48{,}000}{f}$$

where:

d = the distance in metres
f = the frequency in kHz

from the property served. The measurements shall be taken in daylight using a field strength meter operated by an engineer or technician experienced in this work. The readings shall be obtained with the antenna not less than 50 cm nor more than three metres above ground at 12 points spaced as equally as

may be practicable around the property at or within the required distance d.

If there are overhead power cables or other wires connected to the property, readings shall be obtained with the antenna directly under and in the same plane as the wires at the prescribed distance from the property.

Note: Theoretically, at 100% efficiency, the field from a fraction of a mW could exceed the 15 µV/m limit at the defined distance from the source.

The owner and operator of the system is responsible for ensuring that at the defined distance a possible interfering signal from the carrier current system does not exceed the maximum permissible field strength and does not cause interference to authorized radio services. In the event that interference is caused, the operator of the system shall promptly take steps to eliminate the interference and remedial measures would have to be taken to the extent of ceasing operation.

~~2.11~~2.12 Applications ~~B~~based on ~~D~~deletion of ~~A~~assignments in the ~~P~~plan (~~B~~band 535-1605 kHz)

Since a number of the unused Canadian assignments in the p~~P~~lan were based on an estimate of a need in a general area, such assignments may be transferred to an alternate community if the necessary protection criteria are met. The brief shall include a discussion of the assignments available in both communities.

If an application is based on the deletion of an unused assignment, other than a transfer, the applicant shall provide a justification to be evaluated by ISED~~Innovation, Science and Economic Development Canada~~.

~~2.12~~2.13 On-~~A~~air ~~T~~testing ~~P~~procedure

The procedure as outlined in BPR-1, ~~S~~section 1.4 shall be followed.

2.14 Applications for in-band on-channel digital radio broadcasting

Applications for IBOC in the AM band in Canada will be considered on a case by case basis.

IBOC enables broadcasters to simultaneously transmit using both analog and digital signals. Broadcasting undertakings that wish to transmit IBOC shall use the NRSC-5-D or NRSC-5-E standard of the US National Radio Systems Committee (NRSC). The specifications of the NRSC standard are available from the US National Association of Broadcasters (NAB).

An applicant to ISED for IBOC broadcasting shall ensure that all applicable requirements and regulations established by the CRTC are met.

2.14.1 Protection requirements

In general, the protection requirements between analog stations will also prevent most interference cases with IBOC transmissions by these stations. Any reports of interference will be handled on a case-by-case basis. In the event that interference does occur to analog reception as a result of IBOC broadcasting, the IBOC broadcaster will be responsible for remedying complaints of IBOC interference.

This action could include reducing power, altering the radiation pattern of the antenna, as well as cessation of the digital emissions if necessary.

2.14.2 Applications for multiplex operations

Use of IBOC for services not related to broadcasting are subject to radio authorization licensing fees. Refer to Radiocommunication Information Circular RIC-42, *Guide for Calculating Radio Licence Fees*, and CPC--2--1--25, *Radio Station Licensing Procedure for Radiocommunication Service Providers — System Licensing*.

2.14.3 IBOC application requirements

An applicant to ISED for IBOC broadcasting shall follow the process outlined in section 2.1. In addition, the following IBOC specific requirements shall also be included:

- notification of any first adjacent stations within a 500 km radius of the proposed IBOC transmission as specified in section 2.14.4;

- the contour map to be determined is based on reference to the analog contour of 2 mV/m (66 dBµV/m) with symmetric sidebands at maximum limits for the given service mode of operation. The contour shall be adjusted accordingly for asymmetric sidebands and other sideband power levels; and

[Editor's note: The digital coverage contour value is estimated based on NAB publications. ISED welcomes comments from the RABC with respect to setting the contour values to model the digital radio coverage for both daytime and nighttime operation.]

- summary sheet as per annex D complete with specification of IBOC operating parameters.

In cases where analog and IBOC applications are submitted jointly, only one combined application shall be required.

2.14.4 Notifications

The certificate holder(s) of incumbent first adjacent station(s) shall be notified of the proposed IBOC operation. The IBOC applicant shall send a copy of the engineering brief with a covering letter or email to the first adjacent station(s) certificate holder(s), preferably at the date of filing the application with ISED, The first adjacent certificate holder has 30 days after receiving the engineering brief to reply, if so desired.

The IBOC applicant shall send a copy of this letter or email and confirmation of receipt by the first adjacent broadcasting certificate holder, as proof of delivery, to ISED. The letter or email shall advise the first adjacent certificate holder of the proposed IBOC transmission and shall emphasize that the certificate holder's comments shall be submitted to ISED, along with a copy to the applicant, no later than 30 days after receipt of the engineering brief. Where the first adjacent certificate holder offers an objection, the application may not be accepted by ISED, as explained in the next paragraph. If no reply is received within the specified period, ISED will assume that the affected certificate holder agrees with the proposal.

The first adjacent certificate holder shall use established engineering practices in the analysis that they will conduct. Should the affected party offer an objection, ISED reserves the right to make an independent decision predicated on efficient spectrum usage.

3 Technical ~~R~~requirements for AM ~~B~~broadcasting ~~S~~stations in the ~~B~~band 525-1705 kHz

This section establishes the technical requirements to be followed in designing of AM broadcasting stations operating with powers of 100 W or greater in the frequency band 525-1705 kHz.

3.1 Antennas and ~~G~~ground ~~S~~systems

The design of an antenna system for a station shall conform to the following requirements:

(a) vertical radiators shall be used under most circumstances; use of other types of radiators requires special case consideration;

(b) the height of vertical radiators should be at least 1/6 wavelength or equivalent, but not exceed 5/8 wavelength;

(c) top-loading of vertical radiators is sometimes used to increase the effective height. However, this should be avoided whenever possible, since it affects the vertical radiation characteristics. If used, top-loading shall be symmetrical and not exceed 1/8 wavelength equivalent height. When top-loading is achieved by physical additions to the radiator (rather than using the guy wires), such additions shall be taken into consideration in assessing the structural adequacy;

(d) structural adequacy requirements are in BPR-1, section 2;

(e) all antenna towers shall be painted and lighted in accordance with Transport Canada's requirements;

(f) all antenna towers, transmission lines, etc., on which dangerous radio frequency voltages and currents exist, shall be located and protected to preclude the possibility of accidental contact;

(g) ground systems shall consist of at least 120 radial wires evenly spaced and radiating out from the base of the radiating element unless the design of the antenna system is such as to require other configurations. Radial wires shall not be smaller than no. 10 B & S gauge, and should normally be buried no deeper than 20 cm in the ground for a distance not less than 0.25 wavelength from the antenna;

(h) in selecting the site, every consideration should be given to the conductivity of the ground at the site and the complications which may arise in laying the ground systems specified under this technical requirement. To minimize deformities in the radiation pattern, the difference in antenna base elevation of each tower shall not exceed 10% of the physical height of the shortest tower used in the array.

3.2 Ground ~~C~~conductivities

The official ground conductivity values for Canada are contained in the issue of ~~Innovation, Science and Economic Development Canada~~ISED's map entitled *Ground Conductivity Map for MF Broadcasting Band* dated January 1980.

The map consists of five separate sheets labelled Atlantic Provinces, Quebec, Ontario, Prairie Provinces and British Columbia. ~~Individual sheets (or a complete set) are available for download from the following address: http://www.ic.gc.ca/eic/site/smt-gst.nsf/eng/sf09212.html.~~

An equivalent map can be found in Figure 37 of ITU-R Recommendation P.832*: World Atlas of Ground Conductivities*.

The official ground conductivity values for the United States are contained in the Federal Communications Commission's map Figure M3 entitled *Estimated Effective Ground Conductivity in the United States*.

For the above maps, the international border is considered as a conductivity boundary.

Conductivity values from the maps shall be used for all coverage and interference calculations, unless the applicant provides a suitable showing in accordance with ~~S~~section ~~3.2.1~~3.2.1.

3.2.1 Conductivity ~~V~~values ~~O~~other ~~T~~than ~~M~~map ~~V~~values

Conductivity values other than map values will be considered in cases involving calculated interference to existing broadcasting services, if it can be demonstrated, as a result of extensive measurements, that interference is unlikely to occur in practice. Normally, measurements shall be made from the proposed antenna site, using a test transmitter if necessary. The location of the protected contour shall normally be calculated using conductivity values from the map or from some other mutually agreed sources. If agreed by both parties, the location of the protected contour may be derived from the ~~F~~final ~~P~~proof of ~~P~~performance of the affected station.

An applicant proposing the use of conductivity values other than map values shall provide the affected station with one copy of the engineering brief or the appropriate parts thereof at the time of filing the application with ISED ~~Innovation, Science and Economic Development Canada~~.

The affected station shall, upon receiving a copy of the engineering brief proposing the use of conductivities other than map values, either accept or object to the values used. The affected broadcaster shall advise ~~the Department~~ISED and the applicant in writing within 30 days from the receipt of the engineering brief that an objection may be made to the ground conductivity values used by the applicant, as soon as ongoing studies are completed. Failure to respond within the given time limit implies acceptance of the values used.

In the event that the affected station objects to the use of the conductivities involved in the engineering brief, the station shall be invited to participate in a measurement program approved by ISED~~Innovation, Science and Economic Development Canada~~, during which the two parties should reach an agreement as to the acceptable conductivity and thus the allowable radiation to provide protection to the affected station. The measurement program should be undertaken at the mutual consent of both parties. In some cases, it may be necessary to repeat the measurements at a different time of year to take seasonal variation

of conductivity into account. If agreement cannot be reached, ~~the Department~~ISED will assess the application on the basis of the submissions by both parties and its own studies.

If an application is approved on the basis of other than map conductivity values, whether or not an agreement has been reached with the affected station, and if it can be shown that interference occurs in practice, the interfering station shall immediately reduce the radiation towards the affected station. The values of the reduced radiation will be determined by calculations based on map conductivity values or intermediate values mutually agreed upon by both parties. If the appropriate reduction of radiation cannot be made within seven days by adjustment of a directional pattern, it shall be made by reduction of power.

Until a better method is developed to allow for seasonal variation, measurements will have to be repeated under conditions representative of at least two extremes, unless there is agreement from the affected broadcaster.

3.3 Minimum ~~F~~field ~~S~~strength ~~R~~requirements for ~~S~~satisfactory ~~S~~service to ~~M~~metropolitan ~~A~~areas

This section contains the site selection criteria to achieve minimum field strength requirements for service to metropolitan areas.

3.3.1 Requirements

In the selection of a transmitter site for an AM broadcasting transmitting station, the objectives are to provide adequate service to a centre of population usually referred to as a metropolitan area[3] (in which the studio is normally located), and to give maximum coverage to adjacent areas with a minimum of interference to and from other users of the radio spectrum. A metropolitan area is considered to be any area where there are located in a reasonably continuous fashion, industrial or residential buildings on parcels of ground normally referred to as building lots.

Although a minimum intensity of 25 mV/m is desirable to provide a broadcast service to the business and/or factory areas of a city, a minimum field intensity of 5 mV/m is normally required for a residential area.

3.3.2 Selection of ~~S~~site

The power, antenna characteristics and location of an AM broadcast transmitting system shall be selected in compliance with the following:

(a) The 5 mV/m contour and the usable field strength (E_u) nighttime contour, if it exceeds 5 mV/m, shall enclose the metropolitan area.

(b) For proposals in which it is demonstrated that the requirement of (a) cannot be met with respect to the E_u contour, that contour shall enclose at least 50% of the area delimited by the 5 mV/m contour ~~metropolitan area~~.

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[3] ~~A metropolitan area is considered to be any area where there are located in a reasonably continuous fashion, industrial or residential buildings on parcels of ground normally referred to as building lots.~~

(c) Proposals for accepting E_u greater than 25 mV/m shall be supported by sufficient data to justify consideration as a special case.

3.4 Skywave ~~P~~protection ~~R~~requirements

Chapter 4 of the Final Acts of *RJ81* prescribes the protected contours for Class A, B and C stations and the methods to be used in calculating the skywave interference to skywave and groundwave service contours. The *Canada/USA Agreement, 1984*, prescribes the same methods in Annex 2, Chapter 4.

It should be noted that when protecting assignments in Greenland, Saint-Pierre-et-Miquelon, Mexico and the United States, the value of all interfering skywave signals to any of these countries is determined using the 10% skywave curves as defined in paragraph 3.4 of *RJ81*. When protection to all other countries is determined, 50% skywave curves are to be used for all calculations of skywave interfering signals.

In certain instances where skywave interference to groundwave service is being considered, if adequate margin of protection is allowed, and if the protected station is at a considerable distance from the new assignment, it is probable that skywave protection of the transmitter site would automatically provide acceptable protection to the nighttime groundwave service contour. Otherwise, protection shall be provided to the actual service contour. Technical submissions, predicated upon transmitter site protection only, without due consideration given to possible interference occurring within the nighttime groundwave service contour, will be considered to be technically in error and returned for correction.

The E_u, and all interference levels shall be calculated using expanded (or modified, if applicable) patterns.

Stations in the band 1605-1705 kHz are required to protect co-channel allotment areas from skywave interference as specified in Annex 4 of the *Canada/USA Agreement, 1990* for Canada and the United States, and as specified in Annex 1, Chapter 2 of the *Rio 1988* agreement for other countries, e.g. Greenland and Saint-Pierre-et-Miquelon.

3.5 Nighttime ~~P~~protection of the ~~G~~groundwave ~~S~~service ~~A~~area of all ~~S~~stations ~~A~~against ~~I~~interference ~~F~~from ~~A~~adjacent ~~C~~channel ~~S~~stations (b~~B~~and 525-1605 kHz)

This section specifies the nighttime protection requirements of the groundwave service area of all stations against interference from adjacent channel stations (band 525-1605 kHz).

3.5.1 Protection

Chapter 4 of both *RJ81* and the *Canada/USA Agreement, 1984*, requires adjacent channel groundwave protection of the nighttime service area to the 0.5 mV/m contour. Due to the current congestion in the AM band and, since it is not considered necessary to offer a greater degree of protection from interference by adjacent channel stations than that from co-channel stations, a relaxed rule has been adopted for domestic use only. This rule relaxes the nighttime protection criteria of the adjacent channel where appropriate, taking into consideration the co-channel interference.

3.5.2 Nighttime ~~P~~protected ~~C~~contour

For the purpose of calculating the allowable interference signal from an adjacent channel, the nighttime protected groundwave contour is determined as follows:

(a) For Class A stations, the nighttime protected groundwave contour is the 0.5 mV/m contour.

(b) For Class B and Class C stations the nighttime protected groundwave contour of all domestic stations is the 0.5 mV/m contour or the contour corresponding to 20% of the E_u, whichever encloses the smaller area.

3.5.3 Permissible ~~I~~interference ~~L~~level

The maximum level of interfering groundwave signal on the nighttime protected groundwave contour of a station is as follows:

Table 1: Permissible ~~I~~interference ~~L~~level

Frequency separation between stations	Maximum level of interfering groundwave signal
10 kHz	0.5 mV/m
20 kHz	15.0 mV/m

3.6 Groundwave and ~~S~~skywave ~~P~~protection ~~R~~requirements (~~B~~band 1605-1705 kHz)

This section specifies the groundwave and skywave protection requirements (band 1605-1705 kHz).

3.6.1 Protection b~~B~~etween Canadian ~~S~~stations

In general, the protection criteria between assignments in the band 535-1605 kHz apply.

The daytime 0.5 mV/m contour is protected from groundwave interference using the relevant co-channel, first adjacent channel or second adjacent channel protection ratio.

The nighttime E_u or E_{nom} (whichever is the higher value) contour is protected from skywave interference.

The nighttime 20% E_u or E_{nom} (whichever is the higher value) contour is protected from adjacent channel groundwave interference as in ~~S~~section ~~3.5~~3.5.

The 25 mV/m contours of third adjacent channels shall not overlap.

3.6.2 Protection of ~~F~~foreign ~~A~~allotments

Stations in the band 1605-1705 kHz are required to protect the entire allotment areas in other countries from co-channel skywave and groundwave interference and from second adjacent channel groundwave interference.

Protection requirements to first adjacent channel allotments from proposed stations on Canadian

allotments are found in the *Rio 1988* agreement. Since all allotments along the Canada-US border are adjacent channel and there was a need to allow for different rates of usage, the agreement provides guaranteed access and full protection to priority allotments, and equal access to other allotments. While the *Canada/USA Agreement, 1990* contains the same technical criteria for first adjacent channel protection, the Interim Working Arrangement allows for the application of more stringent criteria (unspecified).

3.6.3 Protection ~~B~~between Canadian ~~S~~stations ~~D~~during ~~C~~critical ~~H~~hours

Stations in the band 1605-1705 kHz sometimes experience co-channel diurnal skywave interference during critical hours.

All incoming stations in the band 1605-1705 kHz must protect the calculated E_u or 7.1 mV/m (E_{nom}) groundwave contour (whichever is the higher value) of existing co-channel stations from diurnal skywave interference during critical hours.

Any incoming station in the band 1605-1705 kHz that produces a daytime radiated field towards an existing co-channel station exceeding that which would be produced by a 1 kW transmitter operating into a standard 90º radiator must protect the $E_u/2$ or 3.55 mV/m ($E_{nom}/2$) groundwave contour (whichever is the higher value) of the existing station from diurnal skywave interference during critical hours.

If it is established that an existing station experiences diurnal skywave interference from a co-channel incoming station within the $E_u/2$ or 3.55 mV/m ($E_{nom}/2$) groundwave contour (whichever is the higher value), the incoming station may need to reduce its approved radiation during critical hours towards the existing station to a value not exceeding that which would be produced by a 1 kW transmitter operating into a standard 90º radiator.

3.7 Protection ~~B~~between ~~B~~band 535-1605 kHz and ~~B~~band 1605-1705 kHz

In general, the draft *Canada/USA Agreement, 1990* requires that assignments in the band 535-1605 kHz and allotments in the band 1605-1705 kHz be protected as if the proposed station were in the same band as the protected assignment or allotment.

The same provision will apply for protection between Canadian stations, but Canadian allotments on band 1610-1630 kHz do not have to be taken into consideration by Canadian proposals on band 1580-1600 kHz, since that would completely block any further use of the latter channels.

3.8 "Lock-~~I~~in" of the ~~G~~groundwave ~~S~~service ~~A~~area of ~~S~~second ~~A~~adjacent ~~C~~channel ~~S~~stations

This section defines the conditions in which "lock-in" of the groundwave service area of second adjacent channel stations can occur.

3.8.1 Protection of the ~~G~~groundwave ~~S~~service ~~A~~area of ~~S~~second ~~A~~adjacent ~~C~~channel ~~S~~stations

The criteria for the second adjacent channel protection of the groundwave service are outlined in Chapter 4 of *RJ81*, the *Canada/USA Agreement, 1984* and *Rio 1988*. For broadcasting stations with a second adjacent channel relationship, the required ratio of desired groundwave signal to interfering groundwave signal is 1:30 (-29.5 dB). Therefore, the allowable interfering signal to protect the 0.5 mV/m contour of a station is 15 mV/m.

Past experience has shown that applying this criterion will result in mutual protection for the service areas of the two stations. However, depending upon certain factors such as the power of a proposed station or local ground conductivity, it is possible for the 15 mV/m contour of an existing station to be intersected or completely encircled by the 0.5 mV/m contour of a proposed station.

Because the 0.5 mV/m contour becomes the protected contour, the existing station becomes "locked-in" and is seriously inhibited or prevented from changing its facilities unless the station changes frequency (which is not always possible) or an understanding can be arrived at between the two stations. The purpose of this rule is to permit the "locked-in" station to change its facilities on its present frequency, as long as other application requirements are met.

3.8.2 Application ~~P~~process

The following are the steps to be taken in the process when an application is submitted for a proposed station or a change in facilities of an existing station and the 0.5 mV/m contour of the proposal intersects or encircles the 15 mV/m contour of another station separated by 20 kHz.

(a) The applicant shall send a copy of the engineering brief and a covering letter to the broadcasting certificate holder of the station affected no later than the date of filing an application. A copy of this letter and confirmation of receipt by the affected broadcasting certificate holder, as proof of delivery, shall also be sent to ISED ~~Innovation, Science and Economic Development Canada~~.

(b) If an agreement protecting the right of the "locked-in" station to make future changes of facilities has been reached between the involved parties prior to filing the application, copies of the agreement shall be submitted with the engineering brief as part of the application for a broadcasting certificate. The application is then processed by ~~the Department~~ISED in the normal manner, but the technical evaluation would include an assessment of the constraints involved and the acceptability of the agreement.

However, if no agreement has been reached between the parties prior to filing the application, ~~Innovation, Science and Economic Development Canada~~ISED would process the application as in (b) above but in referring the application to the CRTC, ~~the Department~~ISED would provide an assessment of the constraints involved and would advise that the affected station is aware of the situation. In cases where no agreement has been reached, ~~the Department~~ISED may impose conditions which would protect the rights of the "locked-in" station.

3.9 Image ~~I~~interference

This sections defines the conditions in which image interference can occur and the required protection criteria.

3.9.1 Introduction

When two transmitting stations in the same area operate on frequencies which differ by a value equal to twice the intermediate frequency (IF) of broadcast receivers, image interference may occur to the reception of the station on the lower frequency. Since the nominal IF of receivers used in Canada is 455 kHz with a standard deviation of 4 kHz, interference may be caused to the reception of any station in the range 530 to

800 kHz by a station whose frequency is 900 to 920 kHz higher, i.e., in the range 1430 to 1700 kHz. The interference level has been found to be objectionable to a significant proportion of broadcast receivers where the field strength ratio of the high frequency to the low frequency station signals is greater than 30:1. Although the interference can sometimes be remedied by adjusting receiver IFs, this has been found to be impractical. Therefore, to avoid objectionable image interference situations, there should be no overlap of the 0.5 mV/m contour of the station on the lower frequency by the 15 mV/m contour of the station on the higher frequency.

3.9.2 Proposals ~~P~~predicated on ~~I~~image ~~R~~relationship

Due to the congestion of stations in some areas, it may not be possible to avoid an image relationship in the selection of a frequency. ~~The Department~~ISED would be prepared to consider a proposal predicated on an image relationship provided that the area where the 30:1 field strength ratio is exceeded is small and sparsely populated so that the receivers affected would be few in number and an effective program of adjustment of receiver intermediate frequencies could be successfully carried out. The burden of technical and financial responsibility lies with the applicant of the incoming station having the most recent notification date. This applies to a new station or an existing station applying for a change in facilities, except:

(a) where a 900 kHz frequency separation already exists between stations;

(b) where the station on the lower frequency accepted an area where the 30:1 field strength ratio was exceeded at the time of notification of its present operation. In these cases, the responsibility of the station on the higher frequency is limited to receivers within the 250 mV/m contour under the general commitment in the application form.

3.10 Assessment and ~~C~~control of ~~M~~maximum ~~F~~field ~~S~~strength of AM ~~B~~broadcasting ~~S~~stations

This section contains the requirements for assessment and control of maximum field strength of AM broadcasting stations.

3.10.1 Introduction

Service requirements and constraints related to the siting of AM broadcasting stations may result in high signal strength levels in populated areas. Under these conditions, AM receivers are susceptible to intermodulation interference. Also, broadcast receivers are susceptible to immunity-type interference, and non-radio frequency equipment (radio-sensitive equipment) may be affected as well.

To avoid or to minimize such problems, applicants are encouraged to locate their transmitters away from populated areas. Where this is unavoidable, it is necessary to assess the potential for interference.

3.10.2 Purpose

The purpose of this subsection is to:

- identify the analysis required from applicants in determining interference potential,
- define the responsibilities of the broadcasters in response to interference complaints, and
- identify non-valid complaints of interference.

The requirements of this section apply to all applications for the issue or amendment of broadcasting certificates for class A, B or C AM broadcasting stations.

3.10.3 Requirements for ~~I~~interference ~~A~~analyses and ~~P~~population ~~E~~estimates

In addition to ~~the department~~ISED~~al~~ requirements contained in ~~S~~section ~~2.4~~2.4 pertaining to the engineering brief, interference analyses as per ~~S~~section ~~3.10.3.1~~3.10.3.1 are required. In specific cases, ~~the Department~~ISED may accept a common assessment for co-located stations, multiplexed or otherwise.

3.10.3.1 Protection of AM ~~R~~receivers ~~A~~against ~~I~~intermodulation and ~~C~~cross-modulation

To assess the potential for interference, applicants and existing broadcasters must ensure that their installations are designed and operated in consideration of the following requirements. It must be demonstrated that the transmitting site, the antenna pattern and the power of the station comply as follows:

(a) The population within the day or night 250 mV/m contour shall not exceed one person per watt of transmitter power. For example, for 10 000 watts, the population should not exceed 10 000 persons.

(b) The population enclosed by the day or night 250 mV/m contour shall not exceed one third of the total population in the area delimited by the 15 mV/m contour~~within the centre to be served~~.

(c) The population within the day or night 1 V/m contour should be less than 0.02% of the population within the 5 mV/m contour.

3.10.3.2 Special ~~C~~cases

In special cases, ~~the Department~~ISED may give consideration to a new station or changes to an existing station if the population limits listed in ~~S~~section ~~3.10.3.1~~3.10.3.1 are exceeded, particularly when the limits are already surpassed by the existing population. In such cases, the applicant shall:

(a) submit a study, prepared by a broadcast consultant, to show possible receiver-generated intermodulation and cross-modulation products that coincide with the frequencies of other radio services received within the station's 1 V/m and 250 mV/m contours;

(b) undertake to reduce the power of the station to a level stipulated by ~~the Department~~ISED if there are a substantial number of complaints which cannot be resolved satisfactorily; and

(c) provide recent aerial photographs showing pertinent residential and industrial sites in the area.

An applicant proposing changes to the facilities of an existing station shall submit a commitment to revert to the previous facilities in the event of interference developing.

3.10.4 Resolving ~~I~~issues and ~~R~~responsibilities

This section contains the broadcasters roles and responsibilities in resolving issues.

3.10.4.1 Cases of ~~I~~intermodulation or ~~C~~cross-modulation ~~T~~type ~~I~~interference

The broadcaster will accept responsibility to:

- remedy valid complaints of interference caused by the station to radio frequency devices within the 250 mV/m contour if the receiver was introduced within the contour before the station started operating with the new facilities (refer to ~~S~~section ~~3.10.5~~3.10.5 for list of complaints judged not valid by ~~the Department~~ISED);
- provide technical advice to complainants, located within the service contour of the station, concerning appropriate action to resolve interference problems attributed to the station;
- provide technical advice to complainants to resolve interference problems concerning receivers in motor vehicles in cases where:
  - (a) the interference is to a previously received local station which is separated by ±40 kHz or less from the incoming station; and
  - (b) the interference occurs on a route regularly travelled (at least twice weekly) by the complainant and of which at least 1 km is enclosed by the 1 V/m contour;
- keep the appropriate district office of ~~the Department~~ISED fully informed of all complaints received and action taken.

3.10.4.2 Cases of ~~I~~immunity-~~T~~type ~~I~~interference

Broadcasters will be responsible for solving immunity-type interference for valid complaints. The guidelines on resolving immunity issues related to radio-sensitive equipment are outlined in ~~Innovation, Science and Economic Development Canada~~ISED's Client Procedures Circular CPC-3-14-01, *Determinations of Harmful Interference with Respect to Radio-Sensitive Equipment*. This CPC can also be used as a guide for resolving immunity-related interference to broadcast receivers and associated equipment.

3.10.4.3 In the ~~C~~case of the ~~U~~use of MDCL ~~C~~control

Should any interference to other stations be caused by the operation of MDCL control, the broadcaster will be required to take immediate corrective measure(s) including to the extent of ceasing to use MDCL control.

A station operating with MDCL control shall not claim protection from interference that materialized as a result of the use of this technology.

3.10.5 Complaints ~~J~~judged ~~N~~not ~~V~~valid by ISED~~Innovation, Science and Economic Development Canada~~

This list identifies the types of complaints judged not valid by ~~the Department~~ISED and for which the broadcaster is not responsible for remedial action.

(a) The complaint is attributed to the use of a malfunctioning or mistuned receiver or an

improperly installed or defective antenna system.

(b) The complaint is attributed to the desired signal being received at a location outside of the intended coverage area of the station.

(c) The complaint is attributed to the desired signal not being favourably received because of adverse local propagation conditions or building penetration losses.

(d) The complaint involves the reception of signals originating from outside of Canada.

(e) The complaint involves the malfunction of radio frequency devices that are located inside the 250 mV/m contour, if the devices were introduced within the contour after the station started operating with the new facilities.

(f) The complaint involves a high-gain receiving antenna and/or an antenna booster amplifier intended for reception of distant stations which, as a consequence, overloads the receiver or creates intermodulation in the amplifier output.

(g) The complaint involves intermodulation or cross-modulation interference to AM receivers or radio frequency devices located inside the 250 mV/m contour, if the devices were introduced within the contour after the station started operating with the new facilities.

(h) The complaint is attributed to immunity-type interference in broadcast receivers/associated equipment or in radio-sensitive equipment that are located in areas where the measured field strength does not exceed 1.83 V/m or 3.16 V/m respectively.

(i) Any other complaint which, in the judgement of ~~the Department~~ISED, is considered not valid.

3.11 Special ~~C~~consideration ~~C~~concerning ~~I~~intermodulation and ~~C~~cross-~~M~~modulation ~~I~~interference

When transmitting stations operate in close proximity to each other, there is a possibility of interference resulting from intermodulation and/or cross-modulation at transmitting installations. In selecting a site for a station, every precaution should be taken to avoid locating any transmitter within the 250 mV/m contours of another transmitter. Although it is possible to design installations to tolerate high field strengths from nearby stations, in practice, these would become special cases.

When the 250 mV/m contour of a proposed station or change in facilities of an existing station encloses the transmitting site of another station, ~~the Department~~ISED requires that the applicant's broadcast engineering consultant study the situation, considering potential interference and distortion of the antenna pattern of the other station. If found necessary, suitable filters would be installed at all stations involved to reduce the interference or distortion to an acceptable level. The applicant will bear all expenses, including those due to a loss of revenue resulting from a station having to suspend operation while remedial action is being taken.

3.12 Departures from ~~I~~international ~~A~~agreements for ~~D~~domestic ~~U~~use in Canada

In certain proposals for broadcasting stations, the design of the transmitting facilities is in accordance with the underlying principles of *RJ81*, *Rio 1988* and the *Canada/USA Agreements*, but, under a strict interpretation of the procedures and rules, it depends upon a departure from the accepted criteria.

An example is the case of a protected service contour extending over a body of water, or outlying terrain with no resident population, where the presence of an interfering signal greater than the specified limit would not be detrimental to service. Protection of such areas may require high-cost complex installations and, where that may not be feasible, a loss of usable spectrum or coverage for Canadian stations may result.

Therefore, ~~the Department~~ISED would be prepared to consider such proposals, but only where protection to Canadian stations is involved and provided that the engineering brief presents adequate justification, including :

(a) a detailed analysis demonstrating the unavailability of satisfactory alternative;

(b) documentary evidence as to the extent of resident population within the area of proposed interference;

(c) a list of stations normally received in the affected area;

(d) a detailed analysis concerning the departure from the limiting boundary conditions;

(e) a statement from the licensee of any station affected agreeing to the interfering condition as described under (b) above.

However, the departure from recognized technical requirements, and its effect on existing stations, would have to be examined by ~~the Department~~ISED with the greatest care to determine the acceptability of the application for processing.

Annex A — Sample ~~S~~sheet: Groundwave ~~I~~interference ~~A~~analysis

GROUNDWAVE INTERFERENCE ANALYSIS FOR XXXA, CITY 1 , PROVINCE, POWER: 5 kW, FREQ.: 1000 kHz, CLASS B

PROTECTED STATIONS					PROTECTED STATION TO PROTECTED POINT						INTERFERING STATION TO PROTECTED POINT					
CALL	FREQ. (kHz)	CL.	PWR (kW)	LOCATION	PT.	CONT (mV/m)	RADN (mV/m)	BRG (deg)	DIST (km)	PATH ANALYSIS	RADN (mV/m)	BRG (deg)	DIST (km)	PATH ANALYSIS (Cond./dist.)	PERM SIG (mV/m)	INT SIG (mV/m)
XXXB	1000	B	1	City 2, Prov./ State	A	0.5	391	71.5	136.7	8/136.7	738.5	230	391	6/128.7 2/16.5 10/22.5 8/77	.025	0.174
					B	0.5	379.7	52.5	135.1	8/135.1	782.1	236.5	381.3	6/143 2/149.6 10/16.1 8/77	.025	0.176
					C	0.5	373.3	45	134.3	8/134.3	723.9	239	381.3	6/146.4 2/151 10/27.3 8/72.4	.025	0.0208
					D	0.5	368.5	38.5	133.5	8/133.5	727.3	241.5	389.4	6/154 2/112.6 10/49.9 8/72.4	.025	0.0221
					E	0.5	362	30	131.9	8/131.9	728.9	243.5	399	8/153 2/115.8 10/54.7 8/75.6	.025	0.0149
XX XC	1000	B	10	City 8, Prov./State	A	0.5	1568.8	14.5	232	15/29 10/203	748.2	165	358.8	6/75.6 2/278.3 10/4.8	.025	0.0163
					B	0.5	1562.8	5.5	230	15/32 10/198	764.3	172.5	354	6/77.2 2/197.9 10/77.2	.025	0.0204
					C	0.5	1383.7	353.3	220	15/32 10/188	778.7	181	358.8	6/48.3 2/181.8 10/53 4/11.3	.025	0.0213
					D	0.5	1142.4	343	206	15/37 10/169	785.2	187.5	360.4	6/53.1 2/173.8 10/175.4	.025	0.0224
					E	0.5	828.6	328	186	15/37 10/149	788.4	191.5	436	6/53.1 1/172.2 10/175.4	.025	0.0122

Annex B — Sample Ssheet: Skywave iInterference Aanalysis

SKYWAVE INTERFERENCE ANALYSIS FOR XXXA, CITY 1, PROVINCE															
PROTECTED STATIONS				INTERFERING STATION								INTERFERENCE (mV/m)			
CALL	CL	PWR (kW)	LOCATION	CALL	CL	PWR (kW)	LOCATION	DIST (km)	BRG (deg)	Θ (deg)	RADN (mV/m)	INT (10%)	E_u	PROP RADN	PROP INT
XXXX	B	2.5	City 2, Prov/State	XXXB	B	1	City 2, Prov/State	878.5	304.5	10.4	342.7	4.9			
				XXXC	B	5	City 3, Prov/State	1227.7	104.5	6.1	555.1	4.55			
				XXXD	B	1	City 4, Prov/State	1755.4	328	2.3	307.3	0.96			
				XXXE	B	5	City 5, Prov/State	1108.6	354	7.3	1312.9	13.2*	13.2		
				XXXF	B	50	City 6, Prov/State	2429.6	48	0	2558.3	3.21			
				XXXA	B	10	City 1, Prov	1166.5	282.5	7.0	489.9	4.48		371.8	3.4
XXX1	B	50	City 13, Prov/State	XXXB	B	1	City 2, Prov/State	1327.6	101	5.3	90.1	0.626			
				XXXC	B	1	City 8, Prov/State	810.9	89.5	16.1	18.5	0.288			
				XXXH	B	.5	City 9, Prov/State	381.3	83	25.9	52.6	1.484*	2.43		
				XXXI	B	50	City 10, Prov/State	978.3	39	8.9	156.7	1.918*			
				XXXJ	B	1	City 11, Prov/State	1255	56	6.0	104.1	0.79			
				XXXA	B	10	City 1, Prov	1041	127	8.0	16.1	0.18		93.3	1.044

Note: For the band 1605-1705 kHz skywave, studies are based on protecting allotment areas.

* Contributor to the calculated value of E_u.

Annex C — ITU T04 eElectronic Fformat for MF Ssound Bbroadcasting Sservice in Region 2 Ggoverned by the *RJ81* Agreement

The International Telecommunications Union (ITU) has published guidelines for the submission and notification of electronic notices related to frequency assignments for stations governed by the *Regional Agreement for the Medium Frequency Broadcasting Service in Region 2, Rio de Janeiro 1981* (*RJ81*). This includes Canadian AM stations. Note that since extended or critical hours are not covered by the *RJ81* agreement, any relevant details should be provided in the forms listed in Annex 1, Part IV of the *Canada/USA Agreement, 1984*.

The following is an example of the data format for an electronic notice in ITU T04 format:

<HEAD>
t_adm=CAN
</HEAD>
<NOTICE>
t_notice_type=T04
t_fragment=RJ81
t_action=ADD
t_freq_assgn=1.00
t_long=-0643211
t_lat=+442141
t_site_name=BRIDGEWATER
t_rj81_cls=B
t_ctry=CAN
<OPERATION>
t_op_prd_cde=HJ
t_emi_cls=A3E--
t_pwr_kw=10.000
t_e_rms=917.33
t_bdwdth=10.000
t_ant_type=A
t_e_rms=483.35
t_tran_sys=ANALOG
<TOWER>
t_twr_no=1
t_structure=0
t_hgt_elec=60.000
</TOWER>
</OPERATION>
<OPERATION>

t_op_prd_cde=HN

t_emi_cls=A3E--
t_pwr_kw=10.000
t_bdwdth=10.000
t_ant_type=B
t_e_rms=917.33
t_tran_sys=ANALOG
<TOWER>
t_twr_no=1
t_structure=0
t_fld_ratio=1
t_phase_diff=0
t_spacing=0
t_orient=0
t_hgt_elec=60.000
</TOWER>
<TOWER>
t_twr_no=2
t_structure=0
t_fld_ratio=.51
t_phase_diff=260
t_spacing=90
t_orient=90
t_hgt_elec=60.000
</TOWER>
<TOWER>
t_twr_no=3
t_structure=0
t_fld_ratio=.51
t_phase_diff=100
t_spacing=90
t_orient=270
t_hgt_elec=60.000
</TOWER>
</OPERATION>
</NOTICE>

Annex D — Summary ~~S~~sheet

This annex provides a checklist of information to be included in the engineering brief summary sheet.

General information:

- Applicant name
- Account number
- Station (new or change)
- Principal service location (including province)
- Station call sign
- Originating station (if rebroadcasting)
- Frequency (MHz)
- Channel number (extended band)
- Class of station
- Different parameters during critical hours? (Y/N)

Site details: (*Provide both day and night site details if they differ. Specify critical hours parameters if applicable.*)

- Street address or site name
- City
- Province or territory

Antenna coordinates (WGS84):

- North~~.~~ latitude~~.~~ (degrees/minutes/seconds)
- West~~.~~ longitude (degrees/minutes/seconds).

Transmitter: (*Provide both day and night site details if they differ. Specify critical hours parameters if applicable.*)

- Manufacturer
- Model number
- Certification number

- Output power (kW)

IBOC (if applicable):

- IBOC service mode (MA)
- ERP (lower digital sideband) (dBc)
- ERP (lower digital sideband) (W)
- ERP (upper digital sideband) (dBc)
-
- ERP (upper digital sideband) (W)
-

Field strength:

- RMS field strength value of pattern at 1 km: (*Provide both day and night site details if they differ. Specify critical hours parameters if applicable.*)

Mode of operation:

- Surveillance (attended or unattended)
- Antenna mode (see note 1): (ND, DA-1, DA-2, DA-D or DA-N)
- Audio mode of operation (see note 2): (mono or stereo)

Notes:

Note 1: Antenna modes are defined as follows:

- ND: day and night have non-directional pattern
- DA-1: day and night are directional with same pattern
- DA-2: day and night are directional with different patterns
- DA-D: day has directional and night has non-directional pattern
- DA-N: day has non-directional and night has directional pattern

Note 2: Stereophonic broadcasting shall comply with, Broadcasting Technical Standard BTS-1-1, *AM Broadcasting Stereophonic Operation.*