RE-RADIATION

Broadcasting today is a complex business.

The private broadcaster has to overcome the problems faced by any enterprise, those of staff, of sales, of program or product, of operating economy, of finance. In addition, as part of the Canadian broadcasting system, his role is subject to a frightening array of government policies, rules, regulations, and procedures. At regular intervals, he has to report in great detail the facts of his operation, while at the same time, the CRTC and other Government authorities will call him to task for any dereliction. Regularly he has to face a "public hearing" for license renewal.

While every broadcaster has to accept this bewildering array of requirements, the AM broadcaster must also show that his transmitting equipment and antenna continue to provide coverage exactly in accordance with his licensed parameters, and for this purpose, submits a "Supplementary Proof of Performance", normally prepared by a broadcast consulting engineer on his behalf at 5-year intervals. If not already detected, the consulting engineer will at this point bring to light any problems of re-radiation, the subject of this report.

When one considers that the 107 AM broadcast channels are shared by over 5,000 stations in North America, with some channels being shared by up to 200 stations, it is evident that some form of co-operative mutual arrangement is necessary to prevent chaos on the broadcast band.

The arrangement is NARBA, the "North American Regional Broadcasting Agreement" of 1950. All stations are required to meet the complex rules of this Agreement and in addition, a substantial number of domestic rules applicable in their own country. In Canada, the applicable rules are contained in Broadcast Procedure 1 of the Department of Communications. The result of all this is that many stations are required to use transmitting antennas which direct the power where it is wanted, and suppress the power where it would cause undue interference.

In order to accomplish this aim, it is necessary to place the antenna array in a location substantially clear of any metallic structures of a height greater than 30 or 40 feet. Otherwise, such structures could affect the desired antenna pattern in unpredictable ways, and might result in not only loss of desirable coverage, but far more seriously, power being radiated which causes interference to other stations.

While the broadcaster's original antenna site would have met all the requirements initially, land use in the vicinity of his transmitter, usually completely beyond his control, could easily result in his becoming incapable of maintaining his desired coverage while still affording protection to other stations.

The Supplementary Proof, necessary every five years, would highlight any malperformance of his antenna system, and in all likelihood would not be filed with DOC. More probable would be a crash engineering program resulting in costly or even dangerous detuning procedures for the offending structures, a change in his array as a means to compensate for the undesired effect, or a total change in his transmitter location. Whatever the alternative, substantial expense, running from perhaps $5,000 up to a possible $250,000 would result. It is even conceivable that a satisfactory alternate site could not be found, and the broadcaster would be forced to cease operations entirely.

This problem of re-radiation is becoming more serious as urban areas encroach upon the rural sites chosen initially by the broadcasters to be just a few miles from metropolitan areas.

Because of the long-term applications, the active co-operation of Federal authorities is vital if solutions are to be found which can minimize the problems to be faced. Broadcasters will need co-operation and assistance from Ottawa in discussions with Provincial and local land-use planning authorities. Without such action, the long term projections point to increasing pollution of the airwaves, loss of broadcast coverage, and ultimately the demise of some AM broadcasting stations.

OBJECTIVES

The Canadian Association of Broadcasters believes in a strong Canadian Broadcasting system, of high quality, and of technical excellence. The broadcasting spectrum should be utilized to the highest degree possible, obtaining the maximum benefits for Canada under existing international agreements. To this end, the CAB promotes strict adherence to transmitting parameters, and in particular to protection from harmful interference. Firm measures must be maintained by Federal authorities and by the broadcasters themselves so that gradual and largely unnoticed increases in interference do not ultimately pollute the coverage areas of our stations.

It has been stated by an official of the DOC that, on the average, if spectrum pollution had been controlled from the start, Canadian radio stations could provide service with one-tenth the power needed at present.

Spectrum pollution is an increasing threat to the existence of some stations . . . planning authorities need guidance in planning land-use adjacent to AM transmitter sites. They also need to recognize the value to the community of local broadcast service.

The problems due to re-radiation are already causing continually increasing spectrum pollution and loss of effective coverage from Canadian stations. The Association believes that effective action to halt this deterioration must be taken and at the earliest possible time. The CAB also believes that the responsibility for such action cannot be solely that of the broadcaster. Rather it must be a cooperative thrust shared by the Federal authorities and the CAB.

Where safety of life has been concerned, Ottawa has acted with decision, as exemplified by the zoning requirements stipulated in the vicinity of airports. If technical excellence of our broadcasting system is to be maintained, a similar thrust is needed in regard to transmitter sites.

RE-RADIATION AND ITS EFFECT ON THE PATTERN

Every station licensed with a directional pattern relies on the amplitudes and phases of the tower currents to maintain its licensed pattern, coverage, and protection to other stations, and these parameters have to be controlled to a precise degree.

If, however, an additional structure is erected after these parameters have been precisely set, the electromagnetic radiation from the array can generate electric currents in that structure, and these in turn create an additional electromagnetic field emanating from the offending structure. This new field will add vectorially to the original, changing the shape of the original pattern in unpredictable ways.

This re-radiation is likely to be relatively insignificant in the main coverage directions, but could easily increase the sup-

pressed radiation in the directions of protection to an unacceptable degree. It must be remembered that the field in the main lobe of the pattern may be 50 or more times the field in the suppressed directions. If the offending structure re-radiated even five percent of the main lobe field, radiation from it could quickly destroy the precisely-controlled cancellation in the minimum field directions, and harmful interference would probably result.

Sometimes when re-radiation is found to have affected the field pattern appreciably, the broadcast consultant is able to compensate for it by readjustment of the tuning and phasing equipment. For more severe cases, an additional tower or towers may be required, complete with additional tuning and phasing apparatus. In the worst cases, the transmitting site may have to be abandoned. The more common approach is to attempt to "detune" the re-radiating structure. Various techniques are practiced. Detuning procedures take two forms, either attempts to break-up the currents in the offending structure or attempts to induce equal and opposite currents in wires mounted on the structure so that the resultant re-radiated fields cancel each other. These techniques, while usually successful where individual metallic structures are encountered, cannot be applied when the structures are large buildings.

Whatever the measures taken, they are complex, time-consuming, and invariably expensive.

EXAMPLES OF RE-RADIATION PROBLEMS

An increasing number of our member stations have been affected by re-radiation problems. A few examples are included below.

Hydro Transmission Lines

Normal hydro *distribution* plant rarely has hardware or wires more than 30 to 40 feet above the ground. Though minor re-radiation does occur, it usually has no more than a slight diffusing effect on the broadcast station pattern.

High-tension transmission lines, however, can be a serious problem. Metal structures of up to 250 feet in height may be employed. Generally, a well-grounded structure causes little re-radiation, and electric utilities provide reasonably good grounds for protection from lightning. However, to minimize direct lightning hits on the conductors themselves, and for protection of personnel during electrical storms, a single "sky-wire" is normally run above the power conductors and is bonded to each supporting structure.

When a high-tension line is in the proximity of an AM broadcasting site, detuning practice usually involves "floating" the sky-wire; that is, mounting it on insulators on a number of the hydro structures closest to the transmitting antenna. Hydro authorities have warned that this practice embodies a danger to personnel, for a lightning strike in the segment where the sky-wire is floated could create lethal voltage gradients, not only on the structures themselves, but in the immediate ground area around them. The crest value of lightning strikes may run anywhere between a few thousand and up to 200,000 amperes,

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and averages about 20,000. It takes only a small fraction of an ampere to kill a man. In addition, the floating sky-wire becomes a less-effective shield to the power conductors, and power outages are more likely to occur. Nonetheless most hydro authorities have been very co-operative in taking measures to minimize re-radiation problems, and also have added to the available literature through their own research.

The instances where hydro transmission lines have had to be detuned are very numerous.

High-rise Development

As urban sprawl encroaches upon the area of an existing transmitter site, the usual suburban residential growth, i.e. buildings of one or two stories and hydro distribution systems, cause little problem. However, if this growth includes high-rise development, re-radiation can become serious.

CFRB Toronto has operated successfully from a site on agricultural ground northeast of Oakville for many years. When GO transit was instituted, a railroad station was placed where the railway tracks intersected a main road not far from their property. Local planners and developers were in favour of high-rise zoning on this road immediately in front of the CFRB site where such buildings would be in the main lobe of the radiation. The prediction of re-radiation values from larger buildings is very difficult, and CFRB has gone to major expense in engineering studies, in arguments with planning authorities, and in a continuing fight to prevent high-rise development in the critical area. Ultimately, plans were made to add other transmitter masts to the CFRB array in the hope of compensating, at least in part, for the anticipated re-radiation.

CFRB was fortunate, in that local homeowners also objected to such development. It appears that the ratepayers had more influence than the supplications of the station. So far, construction has been delayed, but the problem has not yet been finally resolved.

Heavy Industry, or a local Broadcast Station?

Rogers Broadcasting, by ingenious design, and by stringent control of an antenna array, were successful in squeezing in station CJKD serving Sarnia, Ontario. The station, south of the city, had to suppress radiation over a broad arc to the west, minimizing radiation into the U.S.A.

However, a major chemical complex, a boon to the Sarnia community, was proposed and with zoning changes was planned to locate immediately next to the transmitter site. In these circumstances the critical antenna array could not continue to serve the city, let alone continue the tight protection necessary for other stations. Despite extended and expensive litigation before the Ontario Municipal Board, Rogers was forced to abandon the CJKD site and to relocate.

Construction which should not have been permitted

CKEC, New Glasgow, Nova Scotia is a small station serving a small community with 5 kW, omnidirectional days, two-tower directional at night. Subsequently a CATV head-end was licensed immediately adjacent to the transmitter site. Even though the broadcaster questioned this construction, building of the head-end structure proceeded, and it soon became apparent that the community had lost much of its daytime signal strength. Tests for the Supplementary Proof of Performance confirmed the serious degradation in the licensed coverage. Detuning of the CATV structure represented a substantial expense for such a small broadcast station, and the owner was unable, short of court action, to obtain any recompense either from DOC or from the CATV company.

This perhaps is a prime example of the need of sympathetic understanding and co-operation on the part of Federal authorities which the CAB believes is so necessary if re-radiation problems are to be minimized or avoided.

LOCAL ZONING AND PLANNING

The technical rules of the DOC, and the rules of common sense, dictate that the broadcaster serve his market with an adequate signal, while not placing a too strong signal over too many homes. The protection of other stations forces him to locate in a fairly restricted direction from his community. He must locate well away from airports. He has little flexibility in his choice of site, generally confined to one direction from the municipality, and neither too far nor too near in order to satisfy the criteria for coverage. When finally located in a satisfactory spot, he is then entirely responsible for maintaining his coverage exactly as stipulated in the license.

What can the broadcaster do to control his environment? When he originally purchases the land and obtains permission to install a transmitter complex, he could advise the local planning authorities that his land-use should result in certain restrictions on future development as far away as one mile from his site. The local taxes from his transmitter property however, would hardly compensate for a virtual freeze over a substantial area on high-rise or heavy industrial development. He can find that his transmitter plant is unwelcome in that particular municipality. Hence it is extremely difficult for the broadcaster to acquire protective zoning for his transmitter site.

It seems obvious that local and Provincial planning authorities need some guidance in their future planning of land-use adjacent to AM transmitter site. They also need to recognize the value to the community of local broadcast service.

Obviously, the broadcaster should also take action. His most positive step would be to ensure that the community so valued his presence that the authorities would weigh carefully the alternatives if land-use planning threatened to curtail or to terminate his local service. Public support would always be his prime weapon, for politicians remain always conscious of voter reaction to their deeds.

RECOMMENDATIONS

The purpose of this report has been to describe in sufficient detail the actual principles by which AM directional antenna arrays function so that a reasonable understanding of the problems of re-radiation is gained. Re-radiation is a significant problem, and growing more serious year by year. It is leading to spectrum pollution, it is costing broadcasters substantial sums of money, and it is an increasing threat to the existence of some member stations.

The CAB recommendations are:

1. that the Department of Communications and the Canadian Radio Television Commission, with additional representation from the Department of Regional Economic Expansion, the Ministry or Urban Affairs and the Canadian Broadcasting Corporation, join with the CAB to create a task force to devise ways and means for ameliorating the problems of re-radiation;
2. that a set of guidelines for land-use in the vicinity of broadcast transmitter sites be published, and that such guidelines be promoted with all land-use planning authorities in Canada;
3. that Federal authorities ensure that their actions do not exacerbate the re-radiation problem unless due compensation is provided the affected broadcasting undertaking;
4. that broadcasters take every appropriate measure to enhance their value to, and their appreciation by the community, to ensure that broadcasting service to the public is accorded the priority it deserves and that the importance of broadcasting to the national fabric of Canada be recognized.

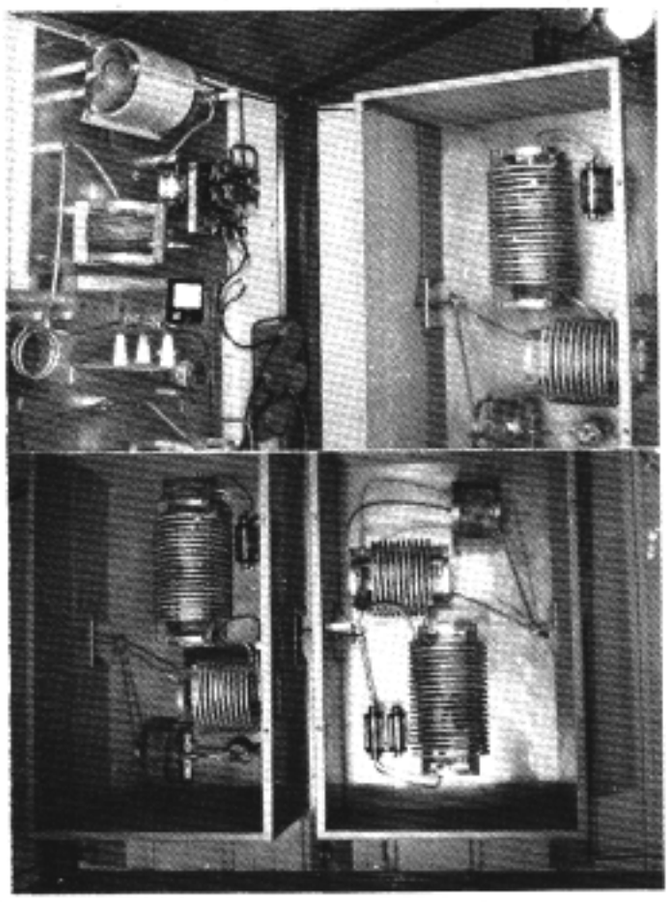
The above article is extracted from a position paper of the Canadian Association of Broadcasters on re-radiation. It was prepared by the CAB Technical Committee for presentation earlier this year to the Department of Communications.

CO-SITING CHWO/CJMR

A Solution to High Land Costs

by Alex Velleman

Signals are transmitted by STL from CHWO Oakville studios to nearby transmitter site, where station engineer Alex Velleman is seen boarding snow vehicle.



Interior of ATU building shows filters which enable CHWO and CJMR—only 60 kHz apart—to use the same array, comprising six-tower parallelogram.

CHWO Halton Radio in Oakville, Ont., had a problem.

We wanted to operate a sister station on 1190 kHz to cover the neighboring municipality of Mississauga.

Our consultants had found the frequency, but wanted 10 to 15 acres of land, south of the Queen Elizabeth Highway between Hamilton and Toronto. If such a package of land could be found, if it could be zoned to permit tower construction, and if we would be assured of little or no high-rise development directly adjacent for 10 to 20 years, it would cost at least $500,000. This alone would rule out the financial practicability of a station for Mississauga.

CHWO Engineering asked our consultants if the existing CHWO six-tower parallelogram would or could serve the proposed area. The answer was "yes". Then came the proposal: why not use the existing array with filters—so that the 1250 ATU would pass 1250 to the tower, and reject 1190 from the tower to the ATU; with a reverse device for the 1190 ATU?

Again, the answer was "yes", this is possible—but is it in fact practical to make such a filter, and if so, would the filter sufficiently reject the undesired signal? Such devices had been used for a single tower (omni) in a pattern, but never for a complete or partial array.

The questions were innumerable: would the pattern shift, if one signal went off-air? Would the filters stay tuned and maintain their rejection and pass qualities? Would a filter be required at each of the transmitters as well, to eliminate any possible intermodulation? Would such intermodulation exist? Would two filters in one ATU interact? How efficient in fact were such filters? With 60 kHz between signals, would such finely-tuned filters have sufficient band pass to permit the full frequency response of the transmitters?

CHWO Engineering was confident that utilizing the existing array, ground plane, ATU buildings and transmitter building could serve two frequencies with minimal interaction, provided exact specifications were followed in the building and installation of the filters.

Management had faith, and gave the consultants the green light to prepare the necessary technical brief. The brief was accepted by the DOC, and subsequently a CRTC hearing resulted. The main technical topic, of course, was the filters. On being assured that better than 30dB of isolation would result, the technical branch of the CRTC seemed satisfied.

In December of 1973 a licence was granted, and in January, 1974, ground was broken to lay the necessary power co-ax control lines, sampling co-ax, etc.

At this point, an interesting thought was entertained. The phasers for both stations were 200 feet or more from the transmitter building, where the phase monitor was normally located. Why not run six more lengths of co-ax from the tx building, back to the phaser, as well as a pair of control lines for the two transmitters? Thus, the phase monitor could be watched when tuning the phaser—resulting in considerable time saving.

Another point: we had, in the CHWO array, several Geleco jacks. These jacks permit the insertion of an RF meter or OIB, on a make before break basis—again resulting in considerable time saving. These jacks were to be inserted at the CP for each station, as well as at each end of each power co-ax run between towers. Thus, changes in the towers could be readily observed once the system was complete—again a time saver to the consultant as well as to repair personnel.

Delivery of the new but identical AM-10000D CCA transmitter then took place, as well as the identical remote control. The PUC installed heavier pole transformers and electricians installed new power panels and switch gear. Our existing surge protector was used, as was our dead phase locator.

Filters started to arrive, and we were amazed and dismayed by their size—as well as by the size of the cage shields. As we had originally ordered them for only four towers (those used by the CJMR array), we had to order additional filters when we found that off-air time for a daytime-only station is not the same as night pattern time for a day/night station. The additional filters were smaller: the same "Q"—2 times the required power for the relevant tower—but not 10 kw, as the others.

A word of caution: follow the design specs to the letter—60 UH means just that, not 59 or 61. Also, if no cage or shield is to be used, this is to be taken into consideration when installing, so that the two filters in one ATU *must* be at right angles to each other to eliminate interaction between filters.

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CO-SITING CHWO/CJMR

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Very little air time was lost on CHWO—only that required to tune the filters and hook them into the system. While this was being done, the Geleco jacks were being installed. When tuned, it was found that the filters were so effective that with 5 kw of 1250 fed into a filter designed to reject that frequency, a 100-watt clear bulb did not even glow dull red when the filters were effectively and properly tuned! The filters which our consultants thought might be needed at the transmitters were not needed. Perhaps this was due to the efficient shielding and design of the transmitters and because identical transmitters were used.

Six and a half months after receiving permission to build, CJMR was on-air.

The intermodulation loss was well in excess of the 30dB guaranteed the CRTC, and the parameters of either station did not change when the other was switched off or on-air, or when one pattern was changed. A simple switching system enabled a common phase monitor, frequency monitor, modulation monitor and audio monitor to be used. Separate ratio meter panels were used, as the information on these was telemetered back to the studios via the remote control systems.

To review the economics of the situation—here they are:

(a) One ground plane and one site for both stations
(b) One set of towers and ATU shacks
(c) One transmitter building
(d) One set of spares for identical transmitters
(e) One set of test gear
(f) One set of tools
(g) One phase monitor, modulation monitor, frequency counter and dummy load.

If construction had taken place for both stations at the same time, one large shack could have been used for all phasers (day and night CHWO and day CJMR) as well as the ATU's for tower 6 for CHWO and CJMR. As it was, we did not have room for the CJMR phaser and had to build an extra shack for it.

The one audio rack accommodated the two remote controls, HI/LO power interface for CHWO, two ratio panels, modulation monitor, phase monitor, audio panel, interswitch and power panel, as well as the Volumax's for both stations and the patch bay.

CHWO and CJMR owe sincere thanks to George Mather and Associates of Mississauga, who designed the system and the filters, and tuned them, as well as to Gerry Lee of Geleco Electronics of Toronto who built them to exact specs. At the time of construction, the filters ran about $700.00 each—well worth the price!

And hats off to management, who, when all is said and done, were the ones who really took the gamble and said "go" to an idea that "should work"—but had never been so extensively applied in the broadcast field before.

Alex Velleman is chief engineer for CHWO Oakville and CJMR Mississauga, Ont.

Problem-Solving at Lindsay

NEW 10 kw PLANT FOR CKLY

Every broadcast installation has its own peculiarities—perhaps that's especially true in Canada, with our varied climatic conditions—and most engineers agree that there's something to learn on each new project.

CKLY Lindsay, Ont., is a case in point.

The station went on the air 21 years ago at 910 kHz with a 1 kw, 3-tower array. Over the years, the Kawartha-Haliburton area, in addition to its normal growth, has attracted growing numbers of winter holidayers, as well as the many cottagers who have long made the area one of Canada's favorite summer resorts. To provide improved coverage of the market, CKLY president J. A. "Pete" McNabb obtained approval for an increase in power to 10 kw day 5 kw night.

The installation, costing $150,000 and completed in the fall of 1973, was shepherded through some unique problems by consulting engineer Gordon Elder, supervising contractor Bill Onn of BES Electronics Ltd. and station engineer Ray McMurray.

The basic problem is the swampy nature of CKLY's 40-acre transmitter site south of Lindsay. In addition, the overflowing of a nearby river makes the towers virtually inaccessible a good part of the year. To ensure proper planning of the new facilities, a thorough survey of the land was first undertaken, charting every foot of elevation.

The transmitter building, located on the highest part of the site, is on a "floating" foundation—a form of construction recommended by a local contractor, Finney Lumber Co. No contractor would even attempt the usual cement block foundation in the "gumbo" soil; but Finney, with local experience, solved the problem with a standard frame building covered with plastic-laminated wood known by the trade name

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NEW PLANT FOR CKLY

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''Colour-lok''. As the name suggests, the material has a sealed finish requiring no maintenance.

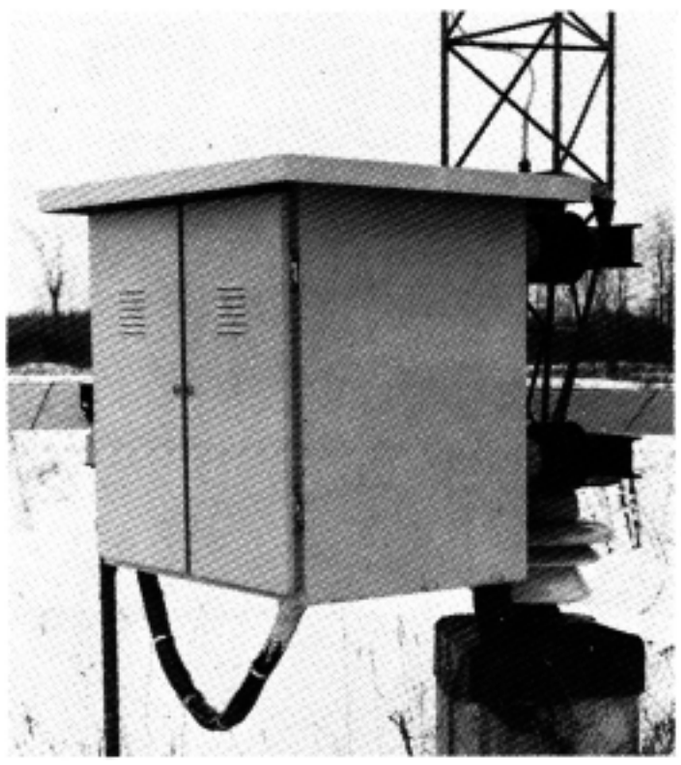
Torsion bars are built into the floor so that the building remains level despite the severe heaving of the ground under it. Constant heat is essential, so there is both electric heat and a propane gas system which takes over in the event of power failure.

CKLY hopes to add FM in the future and the four-room building can be readily expanded. Of economical construction, it is also non-metallic, an important feature for a transmitter site, and has proven very satisfactory for the Lindsay situation.

The power increase required a fourth 250-foot tower. The existing three towers were also fully reconditioned, being straightened, with the bolts between tower sections replaced, new guy wires attached and insulators retensioned—all while the station remained on the air.

The ground system for each tower was also entirely replaced, with the 480 radials—120 for each tower—all installed by hand. Wooden pegs marked the path of each radial which was then laid through the jungle-like growth of the swamp. (The marshy site does have an advantage, of course, in that wet ground systems improve radiation.)

A new method of carrying the RF cable from the transmitter to the towers was also desirable, as the wooden poles and messenger cable originally used were subject to the heaving of the earth. A wooden trough was devised, in which the cable lies loose. Built in 20-foot sections, the trough is supported by steel rods going 20 feet into the soil. While there is movement of the



Aluminum cabinet at base of tower #1 holds antenna tuning unit with high voltage insulators visible at rear. In background is wooden trough carrying RF and power cable.

trough—''a roller-coaster one week and flat the next,'' says McMurray—there is no stress on the cable. At the point where the cable leaves the transmitter building, it passes through a soft caulking compound which also allows flexibility.

Formerly, ''doghouses'' held the antenna tuning units for each tower, and with the earth's heaving, these structures, too, had to be straightened and rebuilt regularly. BES Electronics designed maintenance-free all-aluminum cabinets which are now mounted on the towers, and insulated with the use of four large high-voltage insulators. The feed lines pass directly into the ATU's.

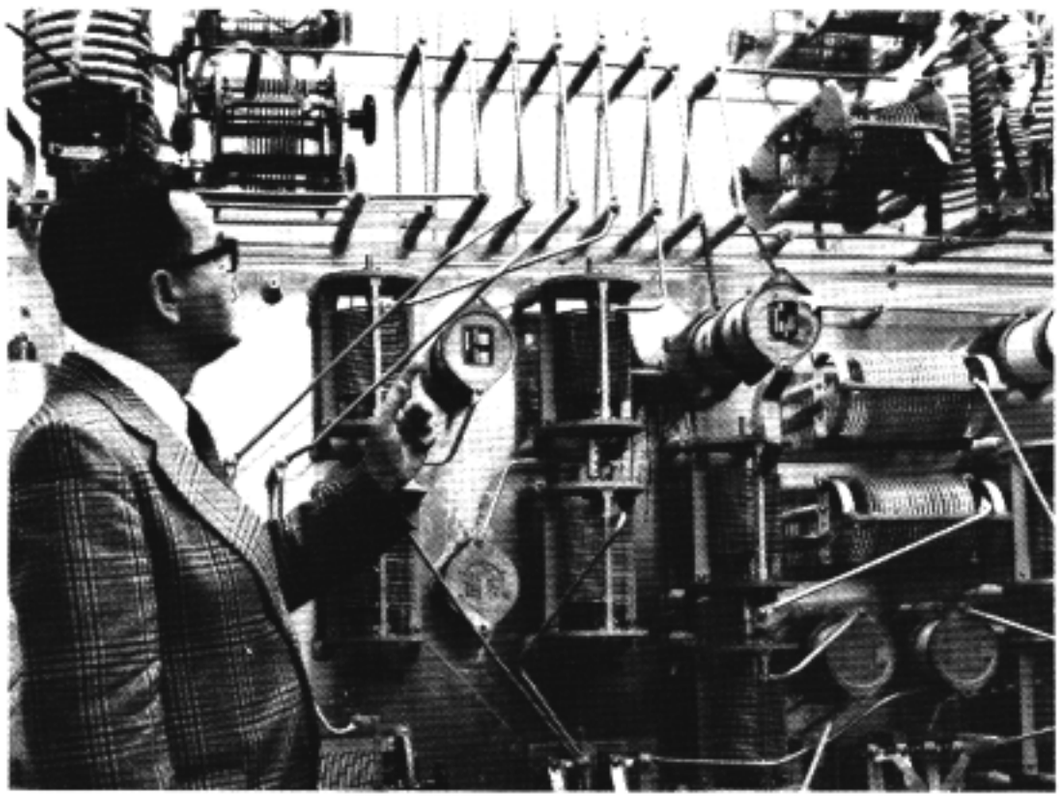
During the construction work, 2000 yards of gravel went into the site, in addition to the cement poured for the new tower foundation. ''We went through four haulage companies,'' says Ray McMurray. The trucks became stuck so often, they wouldn't come back—until McMurray agreed to pay for towing, at times with a tow-truck standing by during unloading operations.

CKLY uses Bell Telephone lines, rather than an STL, and Bell installed new cable the entire 6-mile distance from studios to transmitter, placing it underground at the transmitter site. Hydro also installed several miles of new cables, and the station's engineers give full marks to both utilities for their cooperation.

''The whole plant is brand new, and all the components are the best,'' says Bill Onn. Because an engineer is not always present, the facility had to be reliable, yet have some redundancy, and everything has been built with a capability well in excess of requirements. The CCA 10 kw transmitter—there's also a new 1 kw CCA standby—has never failed or had a problem ''since the day we turned it on''. Remote control equipment is by Moseley Associates, processing equipment is CBS, and the ATU's and phasing units were custom made by BES Electronics.

The plant is a tribute to CKLY and its management. ''Pete'' McNabb considers excellent equipment a priority: ''We never shortchange our equipment and production facilities.'' And, he adds, ''We're never through—you've got to keep doing it all the time.''

And that, too, is something most engineers will agree on.



J. A. ''Pete'' McNabb, president of CKLY Lindsay, views antenna phasing equipment in transmitter building.

Station engineer Ray McMurray checks out CCA 1kw standby, part of all-new transmitter plant.

A CCBA Paper

THE ALL SOLID-STATE TX

by E. C. Westenhaver

There has recently been a number of important developments in AM transmitter design. The last several years have been a period of rapid changes in the old and mature technology of Amplitude Modulation. Since it is important for broadcast engineers to keep their knowledge current and up to date in this field, this paper will review some of these advancements and show how they were incorporated in an all solid state transmitter. It will then discuss several important design areas of the solid state transmitter. These design areas contain fundamentally sound concepts that will be part of basic transmitter concepts for many years. Series modulation, progressive series modulation (PSM), a solid state final amplifier, combining techniques, and some field performance experience will be covered.

Review of Series Modulation

For many years AM transmitters could be loosely grouped into two categories—plate modulated and various transformerless concepts. Most broadcast engineers will agree that the push-pull plate modulated rigs were simple, easy to adjust, reliable, and gave good performance. An illustration of the non-critical nature of high level plate modulation is the fact that most amateur radio AM transmitters were built this way. The transformerless concepts have as a primary goal elimination of the modulation transformer. Good performance was usually realized at the expense of more critical adjustments.

The PDM Concept

The now familiar PDM technique was developed to utilize the best features from both categories. The non-critical plate modulated final amplifier was retained from one category and the elimination of the modulation transformer was used from the other category. PDM can be thought of as a modulated series regulator connecting the power supply and the final RF amplifier. The resulting benefits exceeded those of either category. The term "Series Plate Modulation" describes PDM. This combination of high level plate modulation with an efficient, DC coupled, modulated, series voltage drop connecting the power supply and the final amplifier was so outstanding that Hilmer Swanson of Harris Broadcast Products Division developed a system with the same features optimized for use with transistors. This is the progressive series modulator (PSM) that will be covered in detail later.

The benefits of a series, DC coupled, modulated voltage drop should be recognized because these apply to both PDM and PSM:

1. The fundamentally non-critical, efficient, high level modulated final amplifier is used.
2. The wideband, DC coupled modulator faithfully reproduces the distribution of the input audio peaks. This freedom from overshoot, tilt, bounce, and transient disturbances allows very significant increases in loudness without overmodulation.
3. The series connection allows the modulator to function as a voltage regulator, an output power control, and as an easy, quick method to remove B+ voltage in case of any fault.
4. It is possible to build these modulation systems without critical adjustments or components.
5. These systems can be built with excellent efficiency.

The high value of these benefits has been demonstrated by actual operating experience. These systems will become the "conventional" method in future years.

Progressive Series Modulation (PSM)

The fundamental concept of PSM includes a high level modulated final amplifier. As in the conventional plate modulated transmitter, a specific PA voltage produces an unmodulated carrier. The modulator then produces PA voltage changes that are a linear function of the input audio. The instantaneous PA voltage may go to zero on a 100% negative peak, and to 2.25 times carrier conditions for 125% positive peaks. The audio has an average value of zero. Therefore, the average PA voltage is constant at the unmodulated carrier value.

The concept of PSM includes a modulated final amplifier, two series connected transistors, a power supply voltage of 140, and the 1/2 voltage tap of the power supply connected between the transistors with a gating diode. With this simplified configuration the operation of the modulator is easy to follow. The unmodulated carrier occurs with a PA voltage slightly less than the 1/2 voltage power supply tap. Under these conditions one audio transistor conducts and passes the full PA current from the 1/2 voltage tap through the gating diode. Since the drop across this transistor is low, the power dissipated is low. The other audio transistor is cut off and passes no current.

On a negative modulation audio excursion the drop across the audio transistor increases; therefore, the PA voltage decreases. As 100% negative modulation is approached the PA voltage approaches zero. The PA current approaches zero. Therefore, even though the voltage across the transistor is now high, its dissipation approaches zero. Since the transistor is connected as an emitter follower, the PA voltage is an exact replica of the base voltage with approximately 1 volt base to emitter offset.

On positive modulation excursions the first audio transistor is biased on into saturation. The other transistor begins to conduct, which raises the PA voltage toward the full power supply voltage. Since the emitter voltage rises above the 1/2 voltage tap, the gating diode effectively disconnects the 1/2 voltage tap. The dissipation in the transistor rises from zero at carrier conditions to an instantaneous large value at the beginning of the positive excursion, and again becomes small near full positive modulation. This transistor also acts as an emitter follower; therefore, the PA voltage is a replica of the base voltage.

PSM Circuit Operation

Since the PA presents a linear resistive load to the modulation, the current is much higher on positive modulation excursions than on negative modulation. At the beginning of a positive excursion one transistor has, for an instant, high voltage drop and significant current. This means that the transistor connected to full B+ works harder than the center tap transistor. An efficient selection of transistors results in 2 in parallel in one case, and a 3rd unit of the same type for the other.

The driver stage must provide gain. The driver transistors are also connected as emitter followers. This provides current gain, with excellent voltage linearity.

Since transistors are somewhat limited in base to emitter reverse breakdown capability, a diode is used to disconnect the bases of the upper transistors when the audio drive voltage is lower than the 1/2 voltage tap. The resistor dividers maintain the base voltage near the emitter voltage on negative modulation excursions.

Diodes are used in the base of the lower transistors to provide a controlled voltage drop to divert appropriate base drive current to the upper transistors on positive

(continued on page 20)

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modulation, and to provide a smooth cross-over of the 1/2 voltage region.

The PSM modulator at this point requires an audio drive signal of modest current; with the full peak-to-peak audio swing desired on the final amplifier, and centered at a DC level of the desired PA carrier voltage. Note that this circuit is DC coupled, has no significant frequency components except the transistors, has excellent linearity, and very little phase shift. It is wideband, low distortion, and has excellent transient response. It can be used to adjust output power, perform power reduction, and quickly remove PA voltage, if necessary.

A complete PSM modulator is used on each of the 12 100-watt modules used in the MW-1. Under normal carrier conditions each modulator passes approximately 55 volts at 2 amps to its companion RF final amplifier. It has excellent linearity to almost full power supply voltage of 140 volts, or positive modulation capability of well over 125%.

Solid State Final RF Amplifiers

The solid state final RF amplifier has the same job as in any transmitter. It must convert DC power to RF power with the best possible efficiency and modulation linearity. It is useful to consider this process as a switching process. Although Class D tube type amplifiers are sometimes called switching mode amplifiers, the term does not have wide usage. An analysis of the process of converting DC to RF will show that an ideal switch operating at the carrier frequency is the most efficient method possible. Since transistors can operate as efficient switches, the design and explanation follow this concept.

Push-pull amplifiers have the same advantages for transistors as for vacuum devises. The output power from two devices is achieved in an amplifier with a circuit complexity no greater than a single-ended amplifier. Proprietory engineering studies at Harris Broadcast Products Division have shown that the series connected, push-pull, voltage switching amplifier configuration is best suited for transmitter applications:

- The two transistors are in series between the DC supply voltage and ground.
- The inputs to the bases are 180° out of phase or push-pull connected.
- The RF output is taken from the center connection between the two transistors.

The operation of the amplifier should be visualized as follows: The transistors operate as push-pull or alternate switches. The output voltage at the center connection between the transistors is a square wave switched between the supply voltage and the saturation voltage. Since the output network is series resonant, only fundamental current will flow, and this current is in phase with the voltage waveform. Because the switching occurs rapidly, because the saturation voltage is low, and because the switching occurs during a time when the current is low, then the efficiency is very high.

To understand some of the design principles, remember that the RF output voltage taken from between the transistors is a square wave and that the output current is approximately sinusoidal and in phase with the voltage. The transition occurs at a time of very low collector current. Due to the nature of transistors, this mode of operation is most efficient because the effects of collector storage time are minimized. Consideration of the fact that transistors are fundamentally a device with current gain will show that this mode has simpler base drive requirements. The base current driving waveform can be nearly sinusoidal.

The transition or commutation from one transistor to another must be sequenced so that only one transistor is conducting at any instant. Overlap of the conduction angle, such as occurs in push-pull audio amplifiers, must be avoided. This is accomplished with some small bias similar to grid leak bias.

Each complete 100 watt module is very simple. There is one RF output connection, a 140 volt input, a 70 volt input, an audio input, an RF input, a ground terminal, and a spare. It comfortably produces 100 watts carrier, and 500 watts peak with approximately 13 dB RF gain. The complete module is approximately 1 foot long, and has large area cooling fins to eliminate

thermal cycle fatigue failures.

Combining

Due to fundamental limitations of the output power available from each transistor, many devices must be used for high power solid state transmitters. Therefore, the method of combining the output of amplifiers becomes very important. To simply connect the devices in parallel or in series brings about lack of isolation, unequal load sharing, and awkward impedance matching. The load and performance of many devices can be affected by one improperly performing device.

There are many types of combiners, with the required parameters of isolation and low loss, that have been routinely used at VHF through microwave frequencies for many years. Various hybrid junctions, couplers, and transformers and their matching, isolation, and reciprocal properties are discussed in detail in the microwave literature. One technique best suited for many inputs and small bandwidths is the cable combiner. It consists of 1/4 wavelength transmission lines from each source to a common summing point. There is also a resistor from each source to another point. Each 1/4 wave transmission line functions as an impedance transformer which allows the summing point impedance to be a desirable value.

If each source is delivering the same voltage in the same phase, then there is no power flowing to the resistors. All the power is summed at the output. If any source does not deliver its correct voltage or phase, then a fraction of the total power is dissipated in the resistor associated with the improper source. This property allows a simple RF sensor to indicate any incorrect source. The isolation property of the combiner insures that the load impedance on each source remains constant even if any other source is open or short-circuited. The power dissipated in each resistor does not exceed the output of a single source; therefore, convenient components can be used. This type of combiner can be expanded to accommodate any number of sources or inputs.

Of course, at the standard AM broadcast band 1/4 wavelengths of transmission line are much too bulky to be practical. Therefore, a lumped equivalent circuit is used in the practical transmitter. These 90° networks constructed of a coil and capacitors have the essential electrical properties of a 1/4 wave transmission line for use in a combiner. The coils are slug tuned in unison by the plate tuning control. As in tube transmitters, the plate tuning allows the load impedance to the amplifier to be adjusted to resonant or unity power factor. There is a pilot lamp connected to each reject load to allow a very easy determination of which, if any, module is not performing satisfactorily. The initial factory alignment of the combiner is easy. The slugs in each coil are adjusted so that the associated lamp does not glow. In practice, the combiner has a very satisfactory isolation. This allows each module to contribute full performance even if there is a failure of other modules.

Field Performance Experience

Since an all solid state AM broadcast transmitter is new, performance and actual operating experience are an important indication of the practicability of the concept. The audio performance exceeds that of any other transmitter on the market. The frequency response is specified as less than ± 1 dB from 20 Hz to 10 kHz. Typically it is very flat and smooth, with 0.3 to 0.4 dB drop at the extreme limits. The total harmonic distortion is specified at 1.5% or less, 20 Hz to 10 kHz, 1 KW output and 95% modulation. Typical measurements show less than 1/2% in the mid-audio frequencies, rising slowly to about 1% at 10kHz.

Demonstration of the transient response and positive peak linearity is best done with a function generator and oscilloscope. Use of an asymmetrical ramp shows that the linearity is nearly perfect to over 125% peak positive modulation. Lack of low frequency tilt, good rise time, and freedom from overshoot is also demonstrated. A symmetrical triangle shows excellent linearity from 100% positive to 100%negative modulation. This illustrates why the inter-

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TODAY'S AM TRANSMITTERS

Some of the models and features now on the market

BROADCAST EQUIPMENT TODAY asked manufacturers of AM transmitters to provide an up-date on what they have to offer today's AM engineer. Here are their reports:

AEL

American Electronic Laboratories Inc. manufactures a comprehensive range of AM and FM transmitters. The AM range is:

AM- 5KD 5 kw
AM-10KD 10 kw
AM-50KD 50 kw

In the design of this range of transmitters special consideration has been given to high reliability with all components operating well below their ratings. As with all AEL transmitters, the meter console is located for easy reading of the meters, and the meter panel is hinged and opens forward, giving maximum access for maintenance.

The transmitter control, fault detection, and recycling are accomplished by solid-state logic circuits, and remote control and metering functions are brought out to terminals at the rear of the transmitter for interfacing with a remote control system.

Though all power supplies and the modulation reactor are contained within the cabinet, making the transmitters completely self-contained, the units are very compact.

An adequate supply of air provides long tube life and provides a positive cabinet pressure which prevents the intrusion of dust.

All users of AEL transmitters are protected by a 3-year warranty and a 20-year guarantee of availability of parts.

The Canadian distributor for AEL is M.S.C. Electronics Ltd.

CCA

The complete line of CCA AM transmitters ranges from 4 watts to 100,000 watts.

The low power range consists of the AM 4G, 10G, 20G and 50G (4, 10, 20 and 50-watt) solid state transmitters.

The standard AM range includes:

AM 250DS —250 watts, convertible to 1000
AM 500D —500 watts, cutback to 250
AM 1000D —1000 watts, cutback 500/250
AM 2500D —2500/3000, cutback 1000/500
AM 5000D —5000 watts, cutback 1000/500
AM 10000D —10000 watts, cutback 5000/1000/500
AM 25000D —25000 watts, convertible to 50000
AM 50000D —50000 watts, various cutbacks

CCA's "Dual Reliable" series employs two transmitters in parallel, driven by one of two exciters. The exciters and the transmitters are independently monitored. If a failure results in distortion, or audio or RF degredation, the defective transmitter is turned off and the remaining transmitter is switched directly to the antenna, thereby maintaining 50% of the normal operating power. In the event of degredation or failure of the "on-line" exciter, it is automatically switched on-line. Model numbers in the "Dual Reliable" are AM-1000, 5000, 10000, 25000 and 50000 DX. A 100,000 watt model is also available.

CCA's Canadian subsidiary is Caldwell A/V Equipment Co. Ltd.

Collins

The Collins AM Transmitter line, with power levels of each unit, is as follows:

820D-2: 1000/500/250 watts
820E-1: 5000/1000/500
820F-1: 10000/5000/1000
820H-1 20000/10000/5000/1000

All models are capable of 125% modulation levels and all models offer features such as automatic filament voltage regulation and automatic power control. All are available for frequencies from 535 KHz to 10 MHz and units are tested on customer's frequency before shipment.

The 820H-1 is a dual PA design with automatic switching between PA's to provide redundant operation.

In Canada, Collins is now represented by Applied Electronics Ltd.

Harris/Gates

• The MW-1 (1 kw) is the world's first FCC type accepted AM transmitter. It has two entirely new features—100% solid state design and Harris' patented Progressive Series Modulator, which provides efficient high level modulation. It also features redundant power amplifier and modulator, 125% positive peak modulation capability at 1,100 watts, excellent transient response, complete remote capability and quick accessibility.

• The MW-5 (5 kw) medium wave transmitter uses Harris' patented Pulse Duration Modulator (PDM) to obtain conventional high level plate modulation. The modulator is nearly 90% efficient, allowing an overall transmitter efficiency of better than 52%. The MW-5 features low distortion, excellent transient response, wide frequency response and 125% positive peak modulation capability. Other features include automatic recycling, built-in remote control accessories, excellent accessibility, extensive circuitry protection and quiet air-cooled operation.

• The BC-10H (10 kw) is capable of providing 125% positive peak modulation with plenty of reserve for great reliability. It uses transistors in all circuits except the RF driver, power amplifier and modulator. It also features low operating cost, full accessability and extensive circuitry protection.

• The BC-20H (20 kw) consists of two standard BC-10H, 10-kw transmitters a 20-kilowatt combiner and a common drive unit. Efficiency of the power amplifier is typically 85% or better because of the high efficiency RF circuits utilized. 100% redundancy assures no lost air time.

• In the MW-50 (50 kw), the nearly 90% efficiency of the Pulse Duration Modulation employed permits an overall transmitter efficiency of greater than 60%, for the lowest power consumption of any AM transmitter in this power range. The MW-50 provides 130% positive peak capability when operating at a full 50 kw power output, and uses only five tubes (three tube types). The MW-50 also features easy tuning, automatic recycling, extensive protective circuitry, quiet air cooling and full accessibility to all components.

• The VP-100A (100 kw) has an unusually high overall efficiency of better than 65%, made possible by the almost 90% efficiency of Harris' patented Pulse Duration Modulator. The transmitter employs just five tubes (three tube types), and tube life is extended by Vapor Phase Cooling. Other features include: automatic recycling in case of momentary RF overloads; redundancy in all transistor sections; and extensive protective circuitry. The VP-100A is designed for a wide range of climates.

In Canada, The Broadcast Products Division of Harris Corp. is Gates Radio Co. (Canada).

NEC

Nippon Electric Company's medium-wave transmitters offer excellent performance, high efficiency and compactness. NEC claims these units occupy less floor space and are superior in performance to any comparable equipment in the world. Maintenance is extremely simple and, due to extremely stable performance, the transmitters may be operated unattended, as standbys or in parallel. All tubes and other circuit components are designed and tested for maximum operational life and efficiency to ensure stable operation.

Model numbers are:

MBN-7237 5 kw
MBN-7240 10 kw
MBN-7244 25 kw
MBN-7247 50 kw
MBN-7250 100 kw

All have a frequency range from 525 to 1605 kHz, final stage class B modulation system, and forced air cooling.

Also available are high-power 250, 350 and 500 kw models, with a vapor cooling system.

NEC's AM transmitters will be marketed in Canada through Corporation Telecomex Ltee of Montreal.

RCA

Transmitter models ranging from 5 to 250 kw feature the "Ampilphase" system, first introduced by RCA in 1957.

The Ampliphase system is described as simply the adding and subtracting of the outputs of two CW transmitters, creating the rise and fall in the output signal, corresponding to amplitude modulation. According to RCA, it is a unique way of producing AM which gives the true high fidelity sound of FM.

Ampliphase uses no high power audio circuitry, modulation transformer or any other kind of audio transformer. Exciter and modulator are entirely solid state. The exciter, heart of the Ampliphase system, is built around four plug-in modules. It is completely self-contained and occupies only 5-1/4" of rack space. RF output stages are efficient class C amplifiers. As tubes run at only 50% of their capacity, replacement and operating costs are lower.

Frequency response is factory-tested at 30 to 15,000 Hz—and can range from only 20 to over 20,000 Hz with less than 2% distortion.

All ampliphase transmitters are capable of 125% modulation.

Sparta

The entire Sparta AM line has undergone updating to solid state (except finals) for utmost dependability and low operating cost. The following models are standard:

701 B— 1000/500/250 watts
703 B— 2500/1000/500 watts
705 C— 5000 watts
710 C—10000 watts
715 C—15000 watts
725 C—25000 watts

The 701B is descended from the famous 1 kw Model 707. The 703B, originated in 1967 as an export model, is now type-accepted for 2.5 kw AM operation in the U.S. Both are single cabinet models, the others being dual-cabinet.

Sparta advises that dual redundant systems are available on special order. Components are standardized throughout the line, providing low cost. Maintenance is easy with roomy, uncluttered interiors and the "Tally Light" memory system fault locator.

Low power models are the Model 700 (10 watts) and 720B (50 watts).

Sparta is a division of Cetec Corporation.

CBC-FM's STEREO NETWORK

CBC-FM's STEREO NETWORK

5000 Miles in Hi-Fi!

by M. W. S. Barlow & P. R. Burgess

The FM services of the Canadian Broadcasting Corporation are prestige services offering high technical quality, and frequently carrying programming of highly artistic content. Programming is limited to some 19 hours a day, of which as much as possible is in stereo. No commercials are carried, and simultaneous AM and FM broadcasts are not normally permitted. Sports events are not usually carried on the FM networks, but in addition to musical items, it is intended to present drama and other spoken word programs in the stereo format.

Until recently, the French and English FM services had unconnected stations but no electronic network service between them apart from a 15 kHz monaural English language connection between Montreal, Ottawa and Toronto. Certain programs were distributed to these stations on tape, but in general each station was self-contained and suitably staffed for the whole broadcast day. The economics of this situation meant that the installations were limited to the larger cities where CBC could attach the FM facilities to its AM radio installations, and where, usually, there were also a number of competing private FM stations offering round the clock "majority appeal" programming from automated studio facilities. Although the first CBC FM stations were installed in 1946, by 1973 there were still only six CBC FM stations active.

In 1972 authorization was received to implement network operations for both the French and English services with the intent to gradually extend the networks to additional locations (including affiliated private stations) that might not be economically viable as independent operations. Late in 1974 the French-language stations in Ottawa, Montreal, Quebec and Chicoutimi were connected; the English-language network from St. John's, Newfoundland to Vancouver, British Columbia went into service in the late summer of 1975.

Network Coverage

Initially, all major centres will be network connected (see Fig. 1). This has required the construction of new English production studios and transmitters in St. John's, Halifax and Calgary. Further expansion will also be by connecting affiliates; as FM broadcasting grows in Canada many private FM stations are expected to take some part of the CBC FM output.

There will be construction of additional unattended CBC-owned transmitters to cover unserved areas. It is not anticipated however that the entire country will be covered by this second CBC radio service in stereo for many years. In the sparsely populated areas, for instance, a mix of separate AM and FM programs may be transmitted by the monaural AM service. (It should be noted that some "nominally AM" stations of the CBC actually radiate from FM transmitters due to lack of AM facilities or channels; these transmitters are quite independent of the FM stereo services).

While the four French-language stereo transmitters are all in the same time zone, which makes possible a simple presentation pattern, the eight English stations cover six time zones with a total network length of 5,000 miles, presenting some unusual networking problems in order to satisfy general acceptance of the schedule by listeners. It must also be appreciated that most of the population in Canada is located in a strip 100 miles wide, 5,000 miles long, paralleling the American border.

Network Distribution: ESD

The key to the financial success of the operation lies in the method of distribution of the signals. With a 5,000-mile network, the distribution costs are a large proportion of the annual operating budget.

Many different approaches were analyzed, as shown in Table 1, but a key management decision was made that essentially all network programs should be radiated at the same local time in each time zone across the country. The implication of this decision was that if live distribution was used, then at least four in-line network delay centres would be required to cover the time zones. Because each automatic delay requires at least three tape machines and a complex control system, considerable thought was given to alternatives involving direct tape distribution. Although this approach had some advantages, the

(continued on page 26)

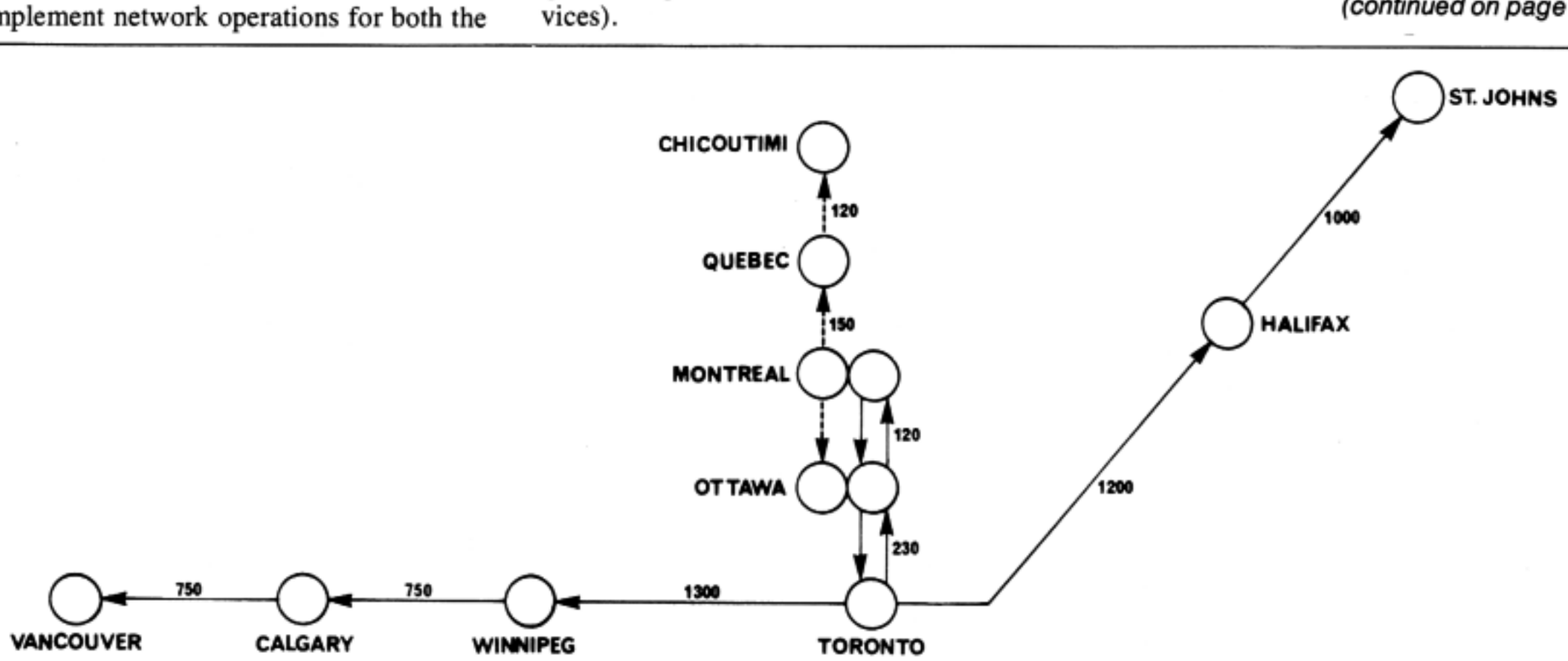

FIG. 1 FM STEREO NETWORKS OF THE CANADIAN BROADCASTING CORPORATION. THE ENGLISH NETWORK IS SHOWN IN A SOLID LINE, AND THE FRENCH DOTTED. DISTANCES ARE IN MILES.

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sheer bulk of tape to provide 14 hours of programs for each of eight stations every day of the year, plus a lesser but considerable amount to future affiliates presented sizeable logistics problems. Live inter-connection was therefore chosen in spite of somewhat higher costs.

The decision was taken to utilize a dedicated independent stereo network, and the common carriers were approached for system proposals. After a technical specification was agreed, tests were made over both the satellite system and over a 7,000-mile microwave loop-back system between Montreal and Vancouver. Both methods were determined as satisfactory, and the less expensive terrestrial microwave circuit was selected. Performance is maintained at a high calibre by not demodulating to audio along the circuit, but rather by providing drop off service to stations along the network. The reduces signal handling to one modulation/demodulation process for each individual station. A suitable routine test arrangement is now being set up by CBC and the telecommunications carriers which will initially be an out-of-service program test procedure; investigations are proceeding for an in-service test so that staff can perform the tests during normal working hours and the results will actually represent circuit conditions during program transmission.

With these decisions made, the network configuration was determined. A network centre is being provided in Toronto to release a complete FM stereo network service at Atlantic time to St. John's, Newfoundland, with a drop off at Halifax, Nova Scotia. The programs will be released one hour later at Eastern time to feed Ottawa, Montreal and the local Toronto transmitter, and also via a Western net, still at Eastern time, to Vancouver, with drop-offs at Calgary and Winnipeg. The delays at the latter three stations would be of three hours, two hours and one hour respectively.

The design of the delay system is based on an existing AM delay centre in Winnipeg. Servo-controlled four-tract record/playback tape units using half-inch tape are arranged to cycle continuously. A 60 Hz tone is recorded on one track for timing control purposes, two tracks are used for the stereo signals and the fourth track is a spare, which may be used in the future for an AM delay. The equipment is self-contained and intended to run unattended for 14 hours a day. This heavy usage requires special attention to machine cooling and daily maintenance to preserve program fidelity.

Some Possible Methods of Network Distribution
(based on one network centre feeding five stations)

System	Mail	TV Channel	Audio Channels	Audio Channels
Delay	1 week	1 day	1 day	None (on line)
BandWidth	—	1 x 4.2 MHz	2 x 15 KHz	2 x 15 kHz
Transmission Time	—	3 hrs/Night (Note 1)	15 hrs/Day	15 hrs/Day
Time Zone Delay System?	No	No	No	Yes
Tape Machines	28	42	34	23 (Note 2)
Staff	8 (Note 3)	8	11	6
Expansion Possibility	Yes	Limited	Yes	Yes
Annual Cost	3/3	3/4 (Note 4)	1	1

NOTES:
1. Three simultaneous multiplexed stereo transmissions at standard tape speed or one high speed transmission at three times normal speed. Method depends on availability of TV network in all time zones for the same period every night.
2. Including three machines per automatic time zone delay.
3. Not including staff (estimated as 12) required to dub 120 hours of tape per day.
4. Dependent upon availability of TV circuits at minimal charge outside of TV hours.

Network Distribution: FSD

The French Language Service originates in Montreal, and is fed over similar high quality network lines to Ottawa and to Quebec and Chicoutimi. (See Fig. 1).

Ottawa has a French-language stereo studio, but Quebec and Chicoutimi act only as rebroadcasters each with a local identification signal source.

Transmitters

A typical transmitter installation for this type of service calls for maximum parameters permitted by the frequency allocation plan, as authorized by the Department of Communications of Canada. For most areas the equivalent of 100 kW of effective radiated power and an effective antenna height above average terrain not exceeding 2,000 ft. is permitted. Such a station will provide urban stereo coverage over a 40-mile radius and rural coverage (requiring a smaller signal) out to 75 miles.

A typical station has an unattended 20 to 25 kW FM stereo transmitter, with an automatic limiter at the input. It is fed from the studios by landlines handling left and right audio signals, or via a UHF STL system which can transmit the encoded FM composite stereophonic signal.

A typical antenna arrangement is a 12 Bay circularly polarized antenna mounted on an 800-foot tower. Other equipment requirements are remote control supervisory equipment, frequency and modulation monitors, and test equipment.

Where the CBC operates two stations, one for French-language FM and one for English, frequency assignments are requested such that the two channels can be diplexed into a common antenna, so as to economize on antenna equipment as well as space requirements on the towers.

Future Development

Expansion of the stereo network service will depend on the availability of funds, now that the technical feasibility has been demonstrated. Coverage expansion in the populous areas of southern Canada will proceed via affiliates and new CBC stations. The requirements for studios in the latter are to be closely scrutinized; the desire for a "local" image being balanced against the cost of a facility to be used only for a few hours each day— the same few hours at each station. The expansion of French service to small groups of French-speaking listeners, and the general expansion to the North, will require additional consideration of the possibilities available by satellite circuits. Changes in the economics of distribution might also occur if digital rather than analogue transmission is utilized.

Technological advances such as Dolby sound and quadraphonic transmission may be incorporated in time, but more urgent answers are required to the problems of in-program quality control testing, network switching from cues radiated from the network centres, and the development of a standard tape leader so that the existing facilities may be used to their maximum capabilities.

The above article is reprinted from the CBC Engineering Review, Vol. 14, with the permission of the Canadian Broadcasting Corporation. *The authors are with CBC Engineering Headquarters in Montreal, where Mr. Burgess is assistant director of the Operations Development Department, and Mr. Barlow is supervising engineer of Studio Systems.*

happenings

• *Toronto TV and FM broadcasters are anxiously awaiting the start of transmissions from the CN Tower—as BET goes to press, it looks like mid-April.*

• Ron Turnpenny reports that with the move CHFI-FM will be using the Dolby model 334 broadcast encoder, recently approved by DOC for use by FM stations.

• *You've been asking who handles Dolby systems in Canada . . . it's J-Mar Electronics, and Alan Indge, who recently moved there from Caldwell A/V, can tell you all about it.*

• Several professional training programs are to be offered during April by the (U.S.) National Association of Educational Broadcasters:
—Audio Production and Design, April 6-9, Madison, Wisc.
—5th Annual Graphics/Design Conference, April 11-14, Lincoln, Neb.
—Film Production for Television, April 25-28, Rochester, N.Y.
For further information regarding these seminars, contact the NAEB Convention Office, 1346 Connecticut Ave. N.W., Washington, D.C. 20036, telephone (202) 785-1100.

• *Speaking of educational broadcasting, the Ontario Educational Communications Authority network, TV Ontario, is now on the air with rebroadcasters in Kitchener and London, joining its stations in Toronto and Ottawa. Chatham and Windsor, delayed by inclement weather, should be on by early summer. Meanwhile residents of the Sudbury area are protesting the postponement of the OECA outlet for that region.*

• After 33 years of continuous service with CKCK and CKCK-TV in Regina, Ian Johnson has now retired. Ian and his wife Marie plan to move to British Columbia in the near future. At a dinner held in his honor, Ian was presented with a WABE retirement plaque for his service to the broadcast industry and several other gifts, including a color television set and 35 mm camera from CKCK-TV and CKCK Radio.

• *Philips Audio-Video Systems tell us that AKG were appointed official microphone and headphone suppliers for those other Olympics—the Winter games in Innsbruck, Austria.*

• Two of Ontario's oldest FM stations have changed call letters. CHEX-FM Peterborough is now CFMP-FM, and CKWS-FM Kingston is CFMK-FM. The new call letters, approved by the D.O.C., are among the last available which include the letters "FM". The change has been made to comply with new CRTC regulations for jointly owned AM-FM stations. New personnel and bright new program formats will also be an important part of their new sound. Originally established in 1948, both stations have antennas located at the 500 ft. level of the towers of their associated TV stations.

John Forrest's Notebook . . .

A lot of the station engineers are now taking a greater interest in the CRTC hearings and attending such hearings—among those seen at recent Toronto hearings were **George Jones** of CHUM, **Ron Turnpenny** of Rogers Broadcasting, **Bruce Carnegie** of CFGM, **Paul Firminger** of CHYM, Kitchener, **Gene Hinz** of CFCO, Chatham, Ont., and **Clive Eastwood** of CFRB.

The interest shown by these engineers is not always because they have a licence renewal but because applications processed could very well affect them.

New around the industry . . .

Wally Labucki of CJCH Halifax, beaming with his eyes aglow because he just got his 4 new Ampex's. Walter is in the process of remodelling the CJCH Radio news facilities.

Dick Parker of CHNS Halifax is in process of moving the studios (he is now armed with a saw!).

Bill Pitcher of CBC Fredericton, N.B., is walking around with color bars in his eyes—he now has a new Plumbicon color camera.

And **Reg McCausland,** VOCM St. John's Nfld., is still trying to find his helicopter!

Most station engineers have by now made their plans for a NAB, which, of course is being held at the McCormick Place in the Al Capone city of Chicago. See you there . . .

Who knows, maybe we can have a banana together!

• *The first "all solid state" commercial AM station in the world has gone on the air in Statesboro, Georgia. Not one tube is used in the broadcast equipment of WTPB supplied entirely by Harris Corp. and including the MW-1 transmitter.*

• TV's critics may see some significance in the date of this year's Canadian Television Commercials Festival in Toronto: April 1st.

• *NRBA, which meets this fall in San Francisco, has announced that Chicago will be the site of its 1977 Conference & Exposition, with Boston the host city in 1978.*

• Fidelipac has announced new prices, effective March 1st. Some are up, some down—and, for the first time, cart replacement parts are listed.

• *The recent Detroit SMPTE conference on TV news gathering and digital video was an unqualified success. Exhibits featured equipment on these topics only—obviously of great interest to the many who attended, and 14 papers were presented on ENG.*

• Our apologies to Leo Gilbeau of Harris/Gates: an Anglophone gremlin must have crept into this column in the Jan/Feb issue, resulting in an incorrect spelling of Leo's name!

• *Andy McDermott—of Andy McDermott Broadcast Sales Ltd.—writes to say that Spence Caldwell should receive much of the credit for the "Canadian Suite" at NAB. Andy says that back in the '50's, Spence—"the busiest retired guy supposedly out of broadcasting"—used to pick up the whole tab. The growing numbers of Canadian attending NAB led to today's cooperative sponsorship. Incidentally, at last count, some 30 firms will be sharing the expenses this year, and they look forward to seeing you in Chicago, March 21-24.*

new product

NEW ROSS SWITCHER FLEXIBLE, LOW-COST

Ross Broadcast Products have announced the introduction of a new switcher, Model RVS 10-4—intended for small studio and mobile applications where maximum production flexibility at minimum cost is required. The RVS 10-4 makes use of the same reliable modules that are already field-proven in the larger RVS 16-4 and RVS 16-6 switchers.

This 10-input, 4-buss switcher features: matte key, chroma key, preview key, split screen, soft key, border, soft wipe, wipe dissolve, colour black and background generator, 24 wipe patterns, positioner. The switcher will be available in single unit and remote control configuration.

For information contact Glentronix Limited, 160 Duncan Mill Road, Don Mills, Ont. M3B 1Z5, (416) 444-8497, or circle #15 on Reader Service Card.

ALL SOLID-STATE TX

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modulation distortion is less than 2%. A 30 Hz square wave shows the excellent low frequency response resulting from a DC coupled modulator. A 1000 Hz square wave shows excellent reproduction. These tests, plus tone bursts, show freedom from phase shift, gain, linearity, tilt, or overshoot problems. A dual trace oscilloscope with highly processed audio on one input, and the transmitter RF output on the other input, shows that the output envelope follows the input faithfully.

The operating experience began with very rugged overstress testing in the factory during the Fall of 1974. The first all solid state MW-1 began full time broadcast service in December 1974 at KXEO, Mexico, Missouri. By December, 1975, Harris had shipped approximately 50 transmitters. There have been enough of these transmitters operating through lightning storms without failure to allow the conclusion that the MW-1 is as safe from lightning as tube type transmitters. The protection techniques, the laboratory testing and the careful analytical work have been confirmed through actual operation experience. The users of these new transmitters are finding that the basic benefits of performance and reliability promised by solid state are actually realized by the MW-1.

Ed Westenhaver is with the Broadcast Products Division of Harris Corporation. This article is a revised version of the paper "Design of a Completely Solid State 1kw AM Broadcast Transmitter", *presented at the 1975 annual engineering conference of the Central Canada Broadcasters Association.*

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CLASSIFIED

directions

A review of recent announcements, decisions and policies of the Canadian Radio-Television Commission.

Editorial

Harry Boyle, named permanent chairman of the Canadian Radio-Television Commission in January, takes over at a time of unprecedented challenges to the authority of the CRTC.

Last December, the Federal Court of Appeal threw out a CRTC decision that required Bushnell Communications to divest its cable television holdings as a condition of its purchase by Standard Broadcasting.

This ruling could affect other CRTC decisions: for example, a similar requirement that IWC Communications divest its cable holdings as a condition of its purchase of Global Television, when Global becomes profitable.

The effect, in this case, is that the CRTC is powerless, in certain cases, to prevent concentration of ownership of the broadcast media.

Another serious challenge came in February, when a Vancouver federal judge ruled that the CRTC must hear an application opposing the renewal of Victoria Cablevision Ltd.

The judge, former federal cabinet minister Jean-Eudes Dube, said that the CRTC must consider a competing *application* by a non-profit group, Capital Cable Co-operative, before it considers the renewal of the licence of the existing operator.

CRTC practice has been to hear only *interventions* in opposition to licence renewals. When, in extreme and rare cases, the commission refuses to renew a licence, it then calls for applications for a new licence.

On learning of the ruling, which came as the CRTC began a scheduled public hearing in Vancouver, the commission postponed its Vancouver and Victoria hearings. Undoubtedly, by the time you read this, the CRTC will have appealed the court's ruling.

In the meantime, the commission is virtually without authority to consider licence renewals under its established procedures. If upheld, the court ruling would bog down the CRTC in tremendous administrative problems.

Allan F. Waters, chairman of the Canadian Association of Broadcasters, stated that CAB supports the CRTC decision to suspend its hearings and urged immediate appeal. He noted that past CRTC policy has ensured that licences are held by responsible citizens and that renewals have always been conditional on licensees operating in the public interest.

Herschel Harden, general manager of Capital Cable Co-operative and a leader of the Association for Public Broadcasting in British Columbia, hailed the judgement as "underlining the fact that licences are for fixed terms, that frequencies are public property."

In his judgement, Mr. Justice Dube said that the CRTC "remains free to decide as it chooses . . . the test (of competing applications) is bound to produce higher standards".

The reality, however, is that such a policy would be extremely destructive of the Canadian broadcasting industry. No business can exist with the threat of extinction hanging over it every five years. What incentive would there be to operate a successful radio or television station or cable TV system, with the knowledge that success would only invite more competition for the licence? Intimidated from every side, broadcasters—far from providing better service—would be reduced to ineffectiveness.

And the threat is not only to management: everyone in the broadcasting industry would be without job security and the benefits of permanent employment.

The objective apparently, is to ensure diversity of ownership in the private sector of Canadian broadcasting. That is a valid and necessary objective.

It is essential that more positive and realistic measures be found to accomplish it.

As BROADCAST EQUIPMENT TODAY goes to press, the CRTC's ability to proceed with the hearing of licence renewals is uncertain (see editorial, this page). However, we understand that scheduled hearings will proceed to consider all other items. Here is a summary of some of the more important matters on the commission's agenda.

VANCOUVER (postponed)

- Application by the CBC for a French-language TV station in Vancouver on channel 26.
- FM applications for Vancouver by CHUM Western Ltd (38,000 watts on 94.5 MHz) and David Ruskin representing Canadian News Radio Ltd., a company to be incorporated, (50,100 watts on 96.1 MHz).
- FM applications for the interior of B.C., by the CBC:

City	Watts	MHz
Kamloops	4,750	94.1
Vernon	1,880	105.5
Penticton	1,840	93.3
Golden	130	101.7

- Interior Broadcasters Ltd. (CJIB) also seeks an FM station in Vernon: 1,200 watts on 100.9 MHz.
- There are three aplications for AM in Vernon: Dennis J. Gerein (730 kHz), Gilway Enterprises (1050 kHz) and Nick Frost (1070 kHz).
- Ralph J. Robinson seeks stations in Penticton (900 kHz) and Oliver (1490 kHz).
- J. David Schmidt seeks to purchase CKKC Nelson and CFKC Creston from Kokanee Broadcasting.
- Power increases have been requested for CHNL Kamloops and CFLD Burns Lake.
- Licences for new cable TV systems in Hope, B.C., are sought by C.A. Towriss and Peter Koch, on behalf of companies to be incorporated.
- Changes of ownership would affect a number of cable systems, notably the purchase of seven B.C. systems and that in Red Deer, Alta. by Microwave Cablevision Ltd., from Community Video of North Vancouver and associated companies.
- Applications for a number of TV rebroadcasters have also been filed for the province, including seven by BCTV.

VICTORIA (postponed)

- Application by the CBC for an English TV station on channel 10, 160,000 watts (video).
- Purchase of CKDA and CFMS-FM Victoria by CHQT Broadcasting of Edmonton, Alta.

REGINA HEARING

• Cable Television for Saskatchewan—until now served only by two small systems near the U.S. border—was the chief topic slated for the Regina hearing.

Competing applications were filed for Regina, Saskatoon, Moose Jaw and North Battleford. Those seeking licences in all four cities include Provincial Cablevision Ltd., J. Ronald Mitchell, on behalf of a company to be incorporated, and Saskatchewan Telecommunications.

Co-operative associations are also in the forefront, with the encouragement of the provincial government.

Other Items:

• An FM application for Regina by David Ruskin on behalf of Canadian News Radio Ltd., a company to be incorporated (100,000 watts on 94.5 MHz).

• A power increase for CBC station CBKF-FM Regina to 13,700 watts.

• A power increase for CJME Regina to 10 kw.

• Power increases for CICC-TV Yorkton and three rebroadcaster also owned by Yorkton Television.

• Change of ownership of CKRD AM/FM/TV Red Deer Alta., to Monarch Broadcasting Co. (CHAT and CHAT-TV), Medicine Hat, Alta.

OTTAWA HEARING

Applications for a new English FM station in Ottawa are among the items scheduled for the March 9th public hearing of the CRTC in the capital city. The three applicants, all representing companies to be incorporated and proposing 100,000 watts on 106.1 MHz, are: David Rusking (see article on Toronto FM, re: Canadian News Radio); Jim Sward, manager of CKGM Montreal; and Harvey Glatt.

• CFML Radio, Cornwall, Ont., seeks a French-language rebroadcaster, 250 watts on 1110 kHz, at Hawkesbury, Ont., and CJSS-FM Cornwall is requesting a power increase from 850 to 9,500 watts, with a change of antenna site.

• CKGB-FM Timmins, Ont., seeks a power increase from 425 to 17,220 watts, with a change of antenna site.

• The CBC has applied for a power increase for CBG Gander, Nfld., to 1,000 watts (day), 500 (night), and a change in frequency for its LPRT CBLH Hornepayne, Ont., from 1090 to 1010 kHz.

• James Allan Waters, representing a company to be incorporated, seeks to purchase CKLC and CKLC-FM Kingston, Ont. A similar application was denied last year.

Several AM stations in Southern Ontario have applied for new facilities:

• CFGM Richmond Hill would move from 1310 to 1320 kHz.

• CFTJ Cambridge would move from 1320 to 960 kHz with a change of antenna site. (It was only last March that CFTJ moved to 1320 to facilitate the move of CKKW Kitchener to 1090 kHz.)

• CHYM Kitchener would move from 1490 to 570 kHz (5 kw day/10 kw night), also with a change of site.

• CFOS Owen Sound seeks a power increase to 2,500 watts, and a new station at Port Elgin (1490 kHz, 1,000 watts day/250 night).

Also requesting a change of frequency is CHNO Sudbury, from 550 to 570 kHz (10 kw day/night).

Probably the most controversial item on the Ottawa agenda, if not postponed, will be the renewal of French TV station CFVO Ottawa/Hull. The co-operatively-owned station has been beset by financial and administrative problems since it went on the air in September, 1973.

DECISIONS

• The CRTC has approved Channel 21 for the new Vancouver TV station licensed to Western Approaches. The agreement leaves channel 26 available for the CBC's projected French-language station.

• An AM network for CJOR Vancouver's Jack Webster open-line show adds CKIQ Kelowna, CHNL Kamloops and CJCI Prine George, B.C.

• Changes of antenna site have been approved for CHRM Matane, Que. and Ex-Cen Cablevision of Exeter, Ont.,

• The application of Richard Acton for a cable system to serve Isle Madame, N.S., is denied. The area has only 700 households.

• **Civitas Corp.** has been denied its application to acquire **Télé Inter-Cité Québec Ltée,** licensed to operate French television service for Montreal (channel 29) and Quebec City (channel 2). Originally scheduled to go on the air in September, 1975,

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Télé Inter-Cité obtained CRTC permission for a postponement to September, 1976, but has been unable to proceed. The Civitas application proposed that channel 4, in addition to 29, be used in Montreal. In denying the application, the CRTC stated that it is not in the public interest to use these two frequencies to carry the same service. The commission also objected to changes in control and reduced programming proposed by Civitas.

• Successful applicants for **cable television licences in Newfoundland are:**

St. John's & Mt. Pearl:
Daniel E. Williams;
Gander & Port-Aux-Basques:
Leonard A. Martin;
Grand Falls & Windsor:
Central Cable Systems Ltd.
Corner Brook & Deer Lake:
Western Cablevision Ltd.
Stephenville: Jean Fowlow

The CRTC notes that "the granting of these licences represents a speculative venture for the applicants". The services offered are largely dependent on reception of U.S. channels relayed from Chamcook, N.B. Rates for microwave are to be based on an equalized charge per subscriber for all systems. In rejecting the proposal of MetroVision Ltd. that U.S. programming be replaced by two channels of taped entertainment, the CRTC said the concept raised questions about program rights, program supply and the future development of pay-TV. The CRTC also states that it favored local ownership and control. Rate structures range from $20 installation and $8 monthly (for Stephenville) to $30 installation and $9.50 monthly (for Gander and Port-Aux-Basques). Included in the monthly rates are microwave costs (ranging from $1.00 to $2.50) and, in St. John's, Grand Falls/Windsor, and Corner Brook/Deer Lake, provision for a 25-cent subsidy for off-air broadcasters. Licensees for these areas are also to make agreements to use the studios of Newfoundland stations to produce community programming for cable television.

• An English and Cree FM station, 78 watts on 94.9 MHz, has been approved for Green Lake Broadcasting Society, Green Lake, Sask.

• A rebroadcaster at St. Anthony for Newfoundland Broadcasting Co.'s CJCN Grand Falls has been approved in principle. The applicant was told to find a different frequency, however, after objections were made by Colonial Broadcasting to the use of 560 kHz, occupied by CHCM Marystown.

SCHEDULE OF HEARINGS

March 9—Ottawa
Skyline Hotel
March 29—Montreal
Quatre Saisons
April 12—Moncton
Cancelled
April 12—Halifax
Lord Nelson
April 26—Edmonton
Edmonton Plaza
May 3—Winnipeg
Winnipeg Inn
May 18—Windsor, Ont.
Holiday Inn
June 8—Ottawa
Chateau Laurier

CBC RENEWAL

Remember the hassle over the renewal of the CBC's licences two years ago? Here's how the question of commercials on the publicly-owned system now stands:

Radio: No commercials except those in programs available only on a sponsored basis (e.g., the Metropolitan Opera) and those required under the Elections Act. Certain CBC stations in unique situations (e.g., rebroadcasters in 27 communities and CJBC Toronto and CBAF Moncton, which are the sole French stations in those cities) may also carry commercial messages "on behalf of any person or group in the community served".

Television: No commercials in children's programming. The proposed condition that the CBC reduce commercials to 8 minutes per hour, as of October 1975, with further one-minute per hour reductions each year thereafter, has been withdrawn by the CRTC, as "all aspects of this matter are being studied further by Cabinet".

GLOBAL "ON NOTICE"

The CRTC has approved Global's use of slide announcements to replace certain programming on its Windsor, Ont., outlet, because program rights for most U.S. shows forbid rebroadcast in the Detroit area. At the same time, it "expects Globel to vigorously pursue remedies for this problem, including sharing of the transmission facilities with other broadcasters and seeking out new sources of programming".

The commission has also placed Global "on notice" that its programming will be reviewed when it is called to a licence renewal hearing in the latter part of 1976. The network's combination of regional news coverage and U.S. entertainment shows has improved Global's ratings, but the CRTC will be taking a close look at both the quantity and quality of Canadian content, along with "a thorough examination of Global's financial situation".

CRTC APPOINTMENTS

Several executive appointments have been made at the CRTC, apparently in preparation for its widened role in regulating telecommunications:

J. Michael Shoemaker is now Executive Director, supervising operations, policy development and staff.

Chris Johnston is General Counsel.

Guy Lefebvre is Secretary General, in addition to his present responsibilities for the supervision of licensing and public hearings.

Jean Baby is Director General, Telecommunications.

Ralph Hart is Special Policy Advisor and Senior Broadcasting Consultant on regulatory policy, providing liaison with the industry.

Pierre Billon is Senior Co-ordinator of Policy Development.

Eric Boyd is Director General, Administration.

FM: Future Muddled?

Toronto hearing bares the complexities of frequencies, foreground, finances

The series of public hearings currently being held by the Canadian Radio-Television Commission will have considerable impact on the future of FM in Canada.

Across the land, applicants are attempting to convince the CRTC that they are qualified to have—or keep—an FM licence. Their various plans will claim to embody "new" approaches to radio which comply with the CRTC's FM Policy.

Some broadcasters—convinced that profitability and compliance with the FM policy are mutually exclusive—will be conspicious by their absence.

The week-long January hearing in Toronto dealt with many of the complexities of opening new vistas on the FM band. Seven stations sought renewals and 11 hopefuls requested a new licence for the Toronto-Hamilton area. Here is a summary of the applications and some of the issues, particularly those of a technical nature, which were discussed.

CKDS-FM Hamilton, established in 1964 as CHML-FM, operates on 95.3 MHz with 200 kw. It will be moving toward "more diversified" programming over the next year to meet the requirements of the FM Policy. Queried on the use of automation, CKDS spokesman Tom Darling said that announcers were always present, even though they may have recorded their material slightly ahead of time for playback on the station's IGM equipment.

Two other commercial channels, 102.9 and 107.9, are assigned to Hamilton. There were three applicants.

McMaster Students Union Inc. wants 107.9 with 81.66 watts to operate a free-form community access station, with an annual budget of $25,000. The applicants said that no "drop-in" channel is available and that their consultant, George Mather, had recommended use of 107.9 in view of their long-range goal of a power increase and stereo.

Burlington Broadcasting Inc. also seeks 107.9 with 50 kw for an "adult" station in Burlington. The company has 23 shareholders, none of whom own more than 17.5%.

Upper Canada Broadcasting Inc. offered a second application for Burlington, proposing 102.9 MHz with 50 kw for a country music format. It was opposed by Mrs. Nancy Carnovale, wife of a Burlington doctor, who noted that control would be held by developer Peter G. Lush, who already has extensive local interests.

The City of Burlington, which has a population of 102,000, made a special representation to ask that a licence be granted. At present, there is no radio or television station or daily newspaper in the community, an affluent suburb where half of the labor force commutes to nearby Hamilton or Toronto.

Both Burlington applications were opposed by Michael Caine of **CHWO Radio,** Oakville, who said that CHWO had been serving the area for 19 years and that there were not sufficient revenues to support two Halton Region stations, where 20 radio and TV stations and 15 newspapers compete for local advertising dollars. CHWO's new sister station, CJMR Mississauga, had a "considerable loss" in 1975, its first year of operation, Caine added.

Lakeland Broadcasting Co. Ltd. filed for renewal of CKQS-FM Oshawa, operating on 94.9 with 100 kw.

CHIC Radio Ltd. applied for renewal for its FM station, now known as CFNY-FM, with a power increase from 857 watts to 100,000 watts on 102.1 MHz. The station also requests a change of location for both antenna and studios to 340 Main St. N., Brampton. Its format was described as advanced rock, with jazz, folk and gospel music elements.

In this, as in other suburban applications, CRTC Chairman Harry Boyle questioned the orientation towards the nearby dominant market, rather than the community in which the station is licensed.

TORONTO

As yet, only four commercial FM stations serve Canada's largest English-language market:

CHFI-FM 98.1
CKFM-FM 99.9
CHIN-FM 100.7
CHUM-FM 104.5

These applied for renewal, and a change of frequency was also requested by CHIN-FM to 107.1 MHz with 40,000 watts.

A field of eight applicants (see chart) argued for a new licence.

Geoff Stirling proposes a contemporary music station which would be "independent"—totally separate from AM—and which would offer radio "under new terms". He scorned news and talk as "a complete waste of a frequency" for FM. Stirling owns stations in Newfoundland, Montreal and Windsor, Ont.

Peter E. Steinmetz also proposes a rock music format on 107.1, noting that the FM spectrum is dominated by adult formats although the youth audience is as large or

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larger. With lawyer Steinmetz in the KOR-FM bid are sports promoter Bill Ballard, researcher Bob Olsen, former CHIN manager Ralph Kirchen and Rainer Schwartz. RCA's Don Dashney is engineering consultant.

Richard Lafferty, for Input Radio, seeks a community access station. Gordon Elder prepared the technical brief for Input, the only applicant for 97.3.

CFGM Broadcasting's Al Slaight proposes a rock album outlet, playing 30% Canadian music. His suburban Richmond Hill AM station has a country format. A site north of Toronto, he said, would result in maximum, omnidirectional use of 99.1, with no interference to the CN Tower.

Service Broadcasting, headed by former North York mayor James Service, wants a local station for North York and Scarborough. He urged the CRTC to licence three new stations for Metro, to stimulate the FM audience.

Neil Lundy offers a sophisticated plan for a station termed ''electric'' in its programming. Shareholders would include architect Raymond Moriyama and musician Peter Appleyard; engineering consultant is Harry Davis.

David Ruskin proposes the first of an 11-station all-news network. With Agra Industries as a major shareholder, Canadian News Radio Ltd. would also seek licenses in Vancouver, Edmonton, Calgary, Regina, Winnipeg, London, Ottawa, Montreal, St. John, N.B., and St. John's, Nfld. ''CNR'' would broadcast news 24 hours a day, contracting with NBC for its international ''NIS'' service. Consulting engineer Israel Switzer and lawyer Jerry Grafstein would also be shareholders of the company, with B. B. Torchinsky as chairman. Anticipated losses during the first three years of operation total $534,000. Switzer said the proposed antenna on the Bank of Montreal would reach a height of 1000 feet, maximizing coverage on 99.1.

Shoreacres Broadcasting (CKEY) seeks a local all-news station for Toronto, where the company, owned by Maclean-Hunter Ltd., has repeatedly sought an FM outlet. Among CFYI-FM's news sources would be Newsradio, which plans an FM service as of September 1, 1976, to meet the needs of broadcasters under the FM Policy. CRTC Chairman Boyle questioned the applicants as to how ''in-depth'' treatment of news would be achieved. Shoreacres anticipates losses for the first four years of operation.

Shoreacres was supported by the **Canadian National Institute for the Blind,** which would use the proposed station's SCMO (Subsidiary Communications Multiplex Operation) for a ''Talking Book'' service to reach an estimated 4,000 blind and 8,000 other handicapped in the Metro area. The CNIB asked that this use of a subcarrier be made a condition of one of the FM licences in Toronto. Stations have been reluctant to offer their subcarriers as it may result in reduced power or quality of signal, or interfere with future purposes such as quadraphonic broadcasting. SCMO requires a special receiver which would cost as much as $200 (CNIB estimates $75-$100). Consultant Switzer observed that there are alternatives to SCMO and that the subject is under active consideration by DOC. If the CRTC considers this a needed service, he said, the Ruskin group is willing to discuss it. None of the eight applicants propose to join in using the antenna of Master FM Ltd. atop the CN Tower. The four existing stations, along with CBC's CBL-FM, share ownership of Master FM and will shortly commence transmitting from the CN Tower. But the would-be newcomers are reluctant to commit themselves to an annual expenditure of $70,000 to $100,000, when other, less expensive sites are available.

Master FM Ltd. has intervened in all eight applications to ask the CRTC to make use of their antenna a condition of any Toronto FM licence. The consortium states that antennas elsewhere could cause local interference to the stations broadcasting from the CN Tower and would reduce the value of Master FM's antenna and of the CN Tower.

CN Tower Limited intervened with similar objections to all applications except that of Shoreacres. Consulting engineer Gordon Elder stated that in 1972, CN Tower was advised by both the CRTC and DOC to provide facilities for all future FM and TV stations in Toronto. The master FM contract, he noted, provides for a review if any applicant considers the charges to be excessive. Any antenna such as that proposed by three applicants for the Bank of Montreal building would generate a new set of ''ghost'' images, seriously impairing the technical merits of the CN Tower.

Shoreacres would locate on the CN Tower, 86 feet below the Master FM antenna, and noted that Master FM had ''made no provision in their design for the acceptance of directional antennas''. CFYI-FM could use either of two locations on the CN Tower at a much lower cost—$40,000 annually on a 10-year lease.

CFTO-TV Limited opposed any plans for an antenna atop the Bank of Montreal's ''First Canadian Place'' tower. The 70-storey skyscraper is in a direct path between the CN Tower and the CFTO-TV studios. President John Bassett said that new evidence had been placed before the Department of Communications by Baton Broadcasting director of engineering Hellmut Berger and consulting engineer Peter Cahn, asserting that the proposed antenna could cause interference to CFTO's STL (studio-transmitter link). While there are conflicting views among engineers on this point, said Bassett, ''once it's done, it's difficult to undo''.

The Canadian Broadcasting Corporation intervened in all applications to state that it will require one of the remaining FM channels for a French FM station. One of the applicants for 99.1 noted that CBL-FM had moved from 99.1 to 94.1 and queried why the CBC would want it back. Applicants also criticized the CBC for not preparing a firm application and suggested that an educational or ''A'' channel should be used for this purpose—96.3, an ''A'' channel, is the remaining commercial frequency assigned to Toronto.

PROPOSALS FOR A NEW FM STATION IN TORONTO

Applicant	Call	MHz	Power (kw)	Format	Antenna Site	Plant Cost (1)
Geoffrey W. Stirling* (Ontario FM Ltd.)	—	107.1	100	Rock	Manulife Bldg.	$271,000
Peter E. Steinmetz*	CKOR-FM	107.1	100	Rock	First Cdn. Tower	$282,875
Richard C. Lafferty* (Input Radio)	CKIR-FM	97.3	20	Access	Manulife Bldg.	$191,000
CFGM Broadcasting Ltd.	CKIN-FM	99.1	100	Rock	Bethesda, Ont.	$250,000
Service Broadcasting Ltd.	—	99.1	62	Local	701 Don Mills Rd.	$159,942
Neil R. Lundy* (S. Ontario Broadcasting)	CJMY-FM	99.1	59.3	Varied	First Cdn. Tower	$299,000
David Ruskin* (Canadian News Radio)	—	99.1	87.5	All-news	First Cdn. Tower	$217,600
Shoreacres Broadcasting	CFYI-FM	99.1	50	All-news	CN Tower	$480,000

* on behalf of a company to be incorporated
(1) cost of leases (e.g., antenna site) is additional, in some cases