Radio Guide

Radio Technology for Engineers and Managers September 2007

FM Antennas to Maximize Analog and Digital Transmission

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Shively Labs

Antennas That Work

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Shively Labs in Bridgton, Maine has been building a reputation for high quality antennas, designed to maximize FM ERP and enhance station coverage, for nearly a half a century. Over the past four and one-half decades, Shively antennas have found their way across the country and around the world.

Shively Labs is named for founder Ed Shively, a broadcast design engineer who had worked at Crosley, RCA and Dielectic. Realizing that the FM spectrum would soon become crowded and good signal coverage – along with the ability to predict and control it – would be essential for a station's success, he focused on developing the sophisticated and rigorously engineered products needed.

Radio Guide

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Cover Image

Paul Ragan adjusts a model on the Shively pattern range.

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Radio Waves

by Barry Mishkind – Editor

Was August just a pause before the storm? After all, September is the month AM IBOC goes 24/7, the NAB holds its Fall Radio Show, and the ***Radio Guide*** AM Transmission Seminar comes to Charlotte, NC. In fact, August was a busy time, too.

This past month, I once again had the privilege of attending the Texas Association of Broadcaster's Convention in Austin, their 54th. And once again, I was impressed. They do it right!

While many might "write off" state broadcast association meetings as a social event, generally useless for the engineering community, some states make a real effort to put together a program that makes the time and expense of getting there well worth it. Texas is one of them.

The Engineering Conference Committee arranged for an excellent program for both radio and television folks, focused on their needs. In addition to important issues dealing with the digital transitions in TV and radio, there was a fine session on planning for disasters and how to quickly recover when one hits. A standing-room-only session dealing with FCC matters was also quite informative. Kudos, guys.

In addition to a large exhibit hall with well over a hundred exhibitors for the 1357 attendees, TAB set aside time between the sessions – even providing lunch and door prizes – which kept the exhibit hall buzzing.

Congratulations, too, to TAB President Ann Arnold, who received the Association's first Lifetime Achievement Award. Arnold's many accomplishments in the 20 years she has worked on behalf of the state's broadcasters include paying good attention to the needs of the engineering community

Continuing educational opportunities are essential to stay on top of technology. State broadcast associations like the TAB can and do make a major difference for engineers.

– Radio Guide –

Shively Labs

Antennas that Work

During a long hot summer, what could be more refreshing than a visit to Maine? This month ***Radio Guide*** *flees the desert for a road trip to the cool climate around Shively Labs' factory.*

Shively Labs in Bridgton, Maine has been building a reputation for high quality antennas, designed to maximize FM ERP and enhance station coverage, for nearly a half a century. Over the past four and one-half decades, Shively antennas have found their way across the country and around the world.

A BRIEF HISTORY

Shively Labs is named for founder Ed Shively. He was a broadcast design engineer who had worked at Crosley, RCA, and Dielectic, where, as Research and Design Chief under Dr George Brown (another RCA alumnus), he designed the RCA BFC- antenna series. (RCA was typically grateful; they gave Shively the usual $2.00 for the patent.)

Ed Shively (1925 -1993)

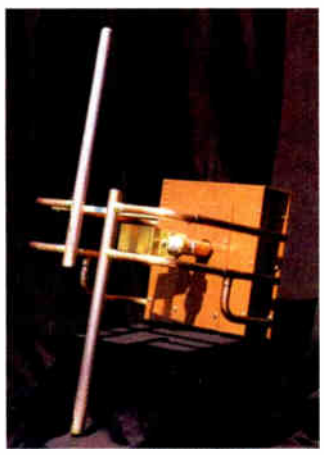
Shively saw the time coming soon when FM broadcasting would grow. Realizing that the FM spectrum would soon become crowded and good signal coverage – along with the ability to predict and control it – would be essential for a station's success, he focused on developing the sophisticated and rigorously engineered products needed.

In 1963, Shively went out on his own, founding Shively Labs to produce antennas for custom projects. While most of the industry was focused using wideband antennas to combat performance issues from icing during the winter time, eschewing the "standard" helix design, Shively pushed the technology of the time and developed a line of ring-stub radiators.

FOCUSED ON FM

Shively started with the 6710, which was the first FM antenna to add a variable vertical component to the standard horizontal antennas of the early 1960s. This design also permitted the user to adjust the horizontal/vertical ratio from elliptical radiation to more circular radiation.

When it was clear that the future would center around circular polarization, Shively modified the 6710 into a fixed-ratio antenna, the 6810 series. Since then, Shively Labs has built up a series of FM ring-stub radiators that remain among the most popular FM radiators on the market.



The distinctive Shively stub-ring antenna elements.

Over four decades later, Shively Labs still produces the 6800 series, from low power to high power, as well as flat panel antennas, Lindenblad antennas and, most recently, antennas with multiple inputs for IBOC transmission. Additionally, Shively manufactures the filters and combiners necessary to operate at combined sites and in high RF environments.

JOINING FORCES

In order to make the company's future more secure, Shively negotiated a sale to a company founded by Peter Howell.

Howell Laboratories had begun by manufacturing high quality dry air machines for military use in the early 1960s. Shively Labs was purchased by Howell in 1980 and combined operations under the Howell Laboratories name, with the broadcast and military manufacturing operating side by side.

The company became employee-owned in 1996, and continues that way to the present.

THE FACTORY

All together, some 60 Shively employees are the engine driving the work in the 33,000 square-foot factory. Engineers, machinists, welders, braisers, assemblers and test technicians, as well as office workers and support staff combine their talents to produce high quality radiators.

The antennas and other products are fabricated on site from primary materials, to assure top quality.

And since no two installations are exactly alike, each Shively antenna is designed, manufactured, assembled, and tested specifically for each customer's application and power level.

BUILDING FOR THE FUTURE

Bob Surette joined Shively after graduation from Lowell Technological Institute (LTI) in 1973. In the succeeding 34 years, Surette has become one of the most respected FM antenna experts in the industry, designing antenna arrays to overcome many difficult transmission issues. He is also well known for his ability to clearly explain the principles of FM transmission (analog and digital) at many venues, including the famous "Bob and Tom" Shows at many NAB Radio Conventions.

Since 1985, Surette has pioneered the use of large combiner networks to co-locate a dozen or more stations on one antenna while overcoming the group delay issues that might have prevented such a system from working. Today, some of these installations combine well over a Megawatt of RF in a reliable, efficient system.

A 16-station combiner at Cougar Mountain in Seattle, WA.

Combiners have also proven useful in providing an input port for digital signals as stations convert to IBOC.

The Cougar Mountain system in Seattle, Washington was one of the first to demonstrate how to inject the digital signal into the "reject" load port. A more recent project at 4 Times Square in New York City challenged Shively to pack a lot of combiner in a small space.

The Shively Combiner at 4 Times Square.

PATTERN MODELING

Perhaps one of the best known outgrowths of the work done at Shively Labs is how they demonstrate the benefits of modeling and testing antennas before mounting them in the field.

In addition to the metal working and fabrication activities, Shively has both an indoor pattern test range – constructed from RF absorbing anechoic material – and an outdoor pattern test range to test the performance of the antennas. With an RF signal to noise ratio of 50 dB, it is possible to measure patterns with extreme accuracy.

The indoor RF anechoic chamber.

The ranges are used regularly to prove the custom designs will radiate as expected.

PREVENTING PROBLEMS WITH RANGE TESTING

A major reason why pattern testing on the test range is so important is that the wavelength at FM frequencies is approximately 10 feet, meaning a quarter wavelength ends up around 2.5 to 3 feet.

In many installations, this is very close to the cross-section width of the tower, which then can act as a parasitic resonator, modifying the radiated pattern of the antenna in unwanted ways. By modeling the antenna on the test range, it is possible to determine what unwanted interactions might exist and mount the antenna in a way that avoids such problems.

The outdoor test range at Shively Labs.

It is interesting to note that at Shively Labs, the test range is done at a 4.5:1 scale. While some manufactur-

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Impossible Remote?
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Broadcasting a live Phoenix radio program from out to sea would be challenging for even the most seasoned veterans. Not for Attorney and Certified Financial Planner® (and world traveler) Keith DeGreen. Keith is shown here using the Comrex ACCESS Portable as he and his ship, The Global Adventure, approach Koror Harbor In The Republic of Palau—450 miles east of the Philippines and 7,200 miles from Phoenix!

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Keith has been broadcasting his radio program, a unique mix of personal finance, economics, politics, and real-life "extreme broadcasting" adventure for 19 years. Listen live 8—11AM Sunday mornings AZ time on NewsTalk 550, KFYI, or catch Keith's archived shows, and enjoy the amazing videos, photos and blogs of his open-ended 'round-the-world journey at his website, www.theglobaladventure.com.

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Shivley Labs

Antennas that Work

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ers suggest that only full scale testing is useful, the experience at Shively is that by scaling the tower, antenna and frequency transmitted, accurate radiation patterns can be measured.

The process identifies not only where the tower might interfere with the signal, but also the mounting position where the signal is launched for best reception in the desired population center. This is especially important with side-mounted antennas, but even pole mounts show the effect of the tower as a parasitic radiator.

Using scale models, Shively can quickly test the effects of various antenna mounting solutions.

However, there is an extra benefit from using a test range like the one at Shively Labs – it is much easier to try different mounting positions for the antenna, as well as any intentional parasitic radiators. Furthermore, modeling the effects from interaction with other antennas on the tower as well as the coax can be done much more easily.

Engineers from all over have come to Bridgton to participate in the range testing. The large number of tests compiled over the years show the likely operation of a new antenna, and real world results in coverage have confirmed the pattern range results. This makes the process of optimizing the antenna a much quicker job than previously.

PARTS AND SUPPORT

Because Shively builds most every part of their antennas, they can provide parts and service for virtually every antenna that has been built at the factory.

Support for an FM antenna is, of course, not always something that is done easily or quickly. With most FM antennas sitting from hundreds to several thousand feet above the transmitter building, it is not easy for an engineer to know the condition of an antenna, unless something drastic happens and something like the transmitter's reflected power meter goes off the scale.

By measuring the radiated pattern of an antenna, the range technician can ensure it can be mounted in the best location to cover a station's market area.

Shively recommends that tower crews check the physical condition of the antenna regularly, as well as doing a transmission system "sweep" to ensure the coax and antenna continue to operate in an efficient manner. If a problem is observed, the factory can assist in repair, or even refurbish the antenna in the factory and return it to the station in "like new" condition.

As for those stations where an engineer finds himself without documentation, Shively maintains a library of drawings for each antenna manufactured, and is happy to help engineers rebuild the documentation on their system.

MOVING INTO THE DIGITAL AGE

As stations began installing digital transmission systems, a lot of research went into how the existing antennas would operate under digital transmission and how to combine the analog and digital signals. Shively has developed several approaches for high level and dual-antenna modes.

Other special projects include combinations of varying element spacing and mechanical and electronic beam tilt. Shively Labs remains committed to developing products to meet the transmission needs of FM broadcasters, keeping RF radiation levels under control around the transmitter site, and putting the RF over the listening area.

Just as Ed Shively anticipated the need for symmetrical and balanced radiators that dominate today's directional and digital antenna markets, Shively Labs works hard at staying on the cutting edge of the new filtering and combining techniques that have changed the face of HD Radio implementation.

The result is, as many engineers have found over the years, that Shively antennas work.

For more information on Shively Labs and their products and services, browse to www.shively.com or call 1-888-Shively.

Wireless Broadband Internet Remotes

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- Christian Vang
Chief Engineer
Clear Channel St. Louis

"The codecs sounded great. My management was very, very impressed with the demos"

- Grady Jeffreys,
Technical Manager,
Mackay Communications

"The remote was a spectacular success, in no small part thanks to the flawless sound which the Tieline G3 provided over the public Internet"

- Mike Rabey
Chief Engineer
Entercom Indianapolis

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Operations Guide

by Roger Karwoski

When the UPS Goes Oops!

Perhaps you are blessed with never having had a power outage or even a fluctuation. However, the majority of us will eventually deal with one or the other. How your computers – and the station – will fare is the question. Roger Karwoski helps get us ready for the worst.

It seems like just a short time ago when I first had to think about "uninterruptible" power. I had to get an "Uninterruptible Power Supply" (UPS) as part of my first server install.

Since that time the number of UPS units in service has grown significantly because the number of mission critical computers has grown significantly! Some computers look like servers. Others look like consoles or maybe exciters. Still, others generate the various components of my HD signal.

GOOD POWER FEEDING

Whatever form the computers take, they all like clean and continuous power. Even a short power outage on some of these pieces of equipment can cause a loss of service for a longer period of time as the device reboots.

The UPS units I use to power these types of devices have a couple of basic – but highly important – jobs:

1. Provide power that is free of surges and transients. A well-made UPS will include surge filters to prevent damage to the attached equipment from transient voltage spikes.

2. Provide power that is stable and continuous during blackouts and brownouts. A well-made UPS unit will switch, not only during a power outage, but also when a brownout occurs. In addition, a good unit will delay returning to the regular AC feed for a few seconds to avoid any sporadic (on-off-on-off-on) power bounces to the equipment.

SELECTING THE RIGHT UPS

In some cases, the task for a UPS is to provide power for a long enough period of time during an outage to allow an orderly shutdown of a computer system. (Generally a COM port or USB port interface between the UPS and the computer allows this to happen automatically.)

In other cases, such as with our control room, we run all our essential equipment off of a UPS, sized sufficiently to keep us running for up to a two-hour outage. It does not happen often but it has happened more than once for us.

Like all good project designs, you need to determine some specific goals first:

Question one: How much power needs to be provided by the UPS?

Question two: How long do I want to operate the equipment during an outage?

American Power Conversion (APC) has a useful UPS size selector that lets you enter your desired power and run time needs to find a suitably sized system. See: http://www.apc.com/tools/ups_selector/index.cfm

STAND-ALONE OR RACK MOUNT?

Rack mounted UPSs, usually one or two rack units (RU) high, are very good at conserving rack space, but come at a price premium. For example, I just looked up the price for a rack mount 1500VA UPS and saw it available for $375. The same sized UPS, from the same manufacturer, sells as a stand-alone tower UPS for $262.

One additional note to pass along: those 1RU and R2U rack mount units are often *deep!* Check the physical dimensions on the UPS you are considering to see if it will fit your rack without hanging way out the back. (Guess what I forgot to measure one time?)

UPS = PERFECT POWER?

So, plugging all your gear into a UPS means that the power will never fail, right? You and I both know better than that. A single UPS is a single point of failure. If the UPS fails, it could cause all the gear attached to it to fail as well.

And UPS's do fail. I have had it happen a few times over the years. There was the time when I had set up a UPS to power our satellite receive demodulators. Unfortunately, the UPS had a failure which caused the AC circuit breaker to trip. The unit ran until the batteries ran out, then the "uninterruptible" power was interrupted!

Another time, I had a small file server that failed when I pressed the "test" button of the UPS. Batteries do die.

REDUNDANT UPS

One solution is using *two* UPS units. Where this level of reliability is needed, I have deployed this method successfully in a couple of different ways.

For example, I have a Dell server that falls into the "mission critical" category. The server itself was ordered with redundant power supplies that had *separate* AC power cords to each of the supplies (not all redundant power supplies do this). To feed AC to this server, I use two UPS units: an older UPS unit (with new batteries) to supply one of the power supplies and a new unit I bought for this project, to power the other power supply.

A dual power supply server with two UPSs

If you *really* wanted to go all the way down the redundancy road, you could have each of the UPS units powered from a different AC circuit, so that even if a breaker failed, the remaining unit would continue the operation.

TRANSFER SWITCHES

In most cases of broadcast equipment, dual AC inputs and supplies are not the norm. In these situations, when I consider the equipment to be "mission critical," I have chosen to make use of an automatic transfer switch in conjunction with two UPS units.

The job of such a transfer switch is to automatically (or manually) transfer the power load between two independent sources, such as two separate UPS units. The transfer takes place when the switch unit senses the line voltage go above or below nominal AC values.

Several companies make transfer switches. My experience has been with units from APC and, more recently, with MGE's Pulsar STS 1400. While MGE's Pulsar unit's control circuitry may not be as sophisticated as APC's, I like the Pulsar's simple and straightforward control interface and find it easier view its status.

APC and MGE transfer switches.

The transfer is quick enough – around 6 to 8 ms – that, in my experience, I have not observed any adverse effect on my equipment. The capacitors in the power supplies of the devices I have used have been sufficient in providing continuous power to the unit during the short switching time.

I experimented with a recent install of a new transfer switch. I switched back and forth, between the sources, several times in succession, and did not have any "burps" from the connected gear. The costs for 1400 VA transfer switches, mentioned here, range in price from $210 to $450.

COMBINED PROTECTION

My most recent setup was for a rack of several new file servers (8+ Terabytes worth.) I designed this system using both types of dual power methods I described above.

The Dell server has dual power supplies, each with a power cord going to a separate UPS unit. Also in this rack are four NAS servers, each with single power supplies. The NAS servers are powered through a transfer switch that is fed from the two UPS units.

In another install, I have two adjacent racks of air chain equipment that need protection and backup. I used a single UPS unit per rack, but ran the AC for each rack through a transfer switch which can "borrow" power from the rack next to it should the UPS for that rack fail.

One of my favorite features of transfer switches is that they allow me to do maintenance on any of the UPS systems at any time of day.

A UPS IS NOT FOREVER

UPS units need to be tested regularly. Such testing can be part of the software on the computer that is connected to the UPS. Also, some UPS units are designed to "self-test" on a regular basis.

The worst thing to do is to install a UPS and assume that it will work forever. I have a monthly routine to manually test the units we use. The interface on the APC units makes it easy to test the system and to monitor the battery voltage during the test. I watch for unusual sags in the battery voltage which are usually good indicators of pending battery problems.

Better UPSs provide visual displays of current conditions.

UPS batteries do need to be replaced on a regular basis. Three to five years is the advice I have heard, so I replace mine every four years and mark the outside of the UPS unit with the date so I know when it is next due for a change out.

Those batteries are not cheap – and neither are good quality UPS systems. But I think buying and maintaining a UPS is like buying insurance. You spend money buying something you hope you will never need. But when you do need it, you sure are glad you invested in it!

Roger Karwoski is the Assistant Manager/Director of Engineering for KBIA at the University of Missouri in Columbia, Missouri. Contact Roger at: KarwoskiR@missouri.edu

Studio Guide

by George Zahn

A Microphone Maker Earns His Ribbons

Long, long ago in a studio far, far away, we started a trek through the universe of microphones and, in this issue, we begin to wrap up our year-long series on those ubiquitous transducers.

We have looked at microphones from the larger corporate manufacturers. This month we meet one of the true "Mom and Pop" companies of microphones, American Engineering Associates (AEA), founded by Wes Dooley.

AEA is one of the last bastions of the ribbon microphone, and Dooley's company of nine people crafts ribbon models that have become indispensable to many users. Nevertheless, his product line is hardly a common feature at radio stations that focus on counting pennies instead of audio qualities when buying microphones.

DOOLEY NOTED

The nephew of 1930's sportscaster Jay Wesley (on WEEI in Boston), Dooley started in FM radio at college in 1963, and fell in love with audio. While colleagues and business partners went on to work with NASA and other technologies, Dooley admits he ignored the advice that "video sells better" when he was in school: "I kept going back to audio because I'm an addict."

Today, in addition to manufacturing high quality products, Dooley traverses the United States speaking about the joys of good audio and the value of microphones.

Dooley's love affair with microphones has been going strong since the 1960's. He learned a valuable lesson about properly using microphones in those dating years when he had a folk music program on the air, "I had dates with girls who called in to the show occasionally. But on a date, they'd say 'You don't sound like you do on the air!'"

Referring to audio quality, Dooley notes, "If you didn't have the right microphone, you couldn't make the difference." If the mantra sounds familiar, it dovetails with the message we have been fostering in these articles. Dooley adds, "The microphone you have, and how you use it, can make a dramatic difference in how you sound."

PUTTING A RIBBON AROUND THE AUDIO

While we have focused mostly on dynamic and condenser microphones for broadcast applications, let us take a short detour back to the world of ribbons – arguably the smoothest, richest sounding of the microphone families.

A well-known recording engineer, Wes Dooley started making a name for himself as a manufacturer when he created a replica version of the RCA 44 in the 1990's. This was in response to what he perceived as an increasing scarcity of the 44s and other ribbon microphones for use in studio and on-location recording.

The AEA R44 made by Dooley was well received. Les Paul hailed the R44 as his favorite microphone; the replica 44 is also used by numerous major producers, In broadcasting, the R44 is now used by major announcers such as nationally syndicated music host Rick Dees, as well as at more than a few "high end stations."

While the original RCA 44 replacement parts are long out of production, AEA makes parts to specification for repair of the RCA classic microphones. AEA even makes replica shells for movie sets and stage work. The product is not inexpensive, but the authentic RCA-44 sound, feel and look make it worthwhile for many artists.

FINDING THE BRIGHT SIDE

Along with the R44 replica, among AEA's most popular microphones are Dooley's newer "big ribbon" designs – the R84 studio microphone, introduced in 2002, and the R92 close-up microphone. Both are based on the original RCA 44 design and are naturally bidirectional. They bear the same internal ribbon element, but they do have a slightly different sound because of the different capsules in which the elements are housed.

"Any piece of 'plumbing' you put in will change the sound," explains Dooley.

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The AEA R44 Ribbon Microphone

SCMS

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1967
First Orban product sold to customer: a stereo synthesizer sold to WOR-FM, New York.

1972
Bob Orban's first of 24 patents issues (U.S. #3,670,106, "Stereo Synthesizer").

June 2007 ❖
SCMS acquires assets of Major Broadcast Equipment Supplier

2005
Orban Optimod 8500 Third Generation of Digital Processing is released and takes audio processing to a new level of industry setting standard.

1975
OPTIMOD 8000 audio processor introduced for the new FM format. Bob Orban and partner, John Delantoni, set up Orban Associates as a privately held company.

2003
OPTIMOD-FM 8300 is introduced at NAB in Las Vegas. OPTIMOD-PC ships. World's first audio PCI Sound Card with Optimod-class DSP for broadcast signal processing.

2007*
Orban begins shipping the new Optimod 6300 high-quality, multipurpose stereo audio processor for digital radio, digital television, netcasts, STL protection, satellite uplink protection, and digital mastering.
Orban also introduces the all-digital 9300 Optimod-AM audio processor for monophonic AM shortwave, medium wave and long wave broadcasts.

Orban Optimod 6300

Three Processors in One:

1. A no-compromise processing chain for digital transmission and media
2. A studio AGC (with peak limiting for STL protection)
3. A talent headphone processor

1976
SCMS founded by Bob Cauthen

2000
Orban Optimod 8400 Second Generation of Digital Processing is released to immediate great reviews and becomes the new industry standard.

Orban Inc. is purchased by CRL from Harman International.

1978
OPTIMOD-AM 9000A offers AM stations a more "FM-like" sound quality and reduced interference. In modified form, the receiver equalizer and low-pass filter ideas form the basis for the NRSC-1 standard issued in 1987.

1996
First low-priced, all digital processor for FM introduced, OPTIMOD-FM 2200. The DSE 7000FX introduced with new DSP engine offering on-board effects like reverb, equalization and compression.

1983
OPTIMOD-TV Model 8182A introduced. Adds Hilbert-Transform clippers and a CBS Loudness Controller to the original 8180A.

1991
Orban leads the transition to digital with the first successful DSP-based FM audio processor, OPTIMOD-FM 8200. Thousands on air around the world.

1987
Orban's first product using micro-processor technology is introduced. The 787A Programmable Mic Processor incorporates equalization, compression, and de-essing in a digitally-controlled analog signal path.

Here for the Long Haul!

* Go to http://www.orban.com/about/timeline/ for a full look at Orbans timeline

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Studio Guide

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A Microphone Maker Earns His Ribbons

"All three of our microphones have the same ribbon size, material and design of the 44, but the internal geometry of the pole pieces and the protection for the ribbon will create a slightly different sound."

Dooley pointed out that the 84 and the 92 "figure eight" designs are designed to give a slightly brighter reproduction on one side of the microphone than the other. According to Dooley, "Because they're designed for closer use, you can flip it around, hit the polarity switch and have a slightly different flavor."

Dooley adds that additional filters which were on older ribbon microphones are really not necessary on today's models because "virtually everyone has access to equalization nowadays." The R84 is largely designed for close up use at 12-18 inches from the announcer; the R92 is used for even closer work at 6-8 inches.

The R84 is a more modern rendition of the RCA 44, in a package reminiscent of the RCA 77.

The R84 and R92 list at $1100 and $900 but have been loaned out through NAB shows to major program producers and network hosts.

"A Sturdier Ribbon Mic"

From my very first audio class in college, I was warned of the fragility of the ribbon microphone. The tenuous mounting of the ribbon made it a non-choice for incredibly high sound pressure levels, rough handling, or most any outdoor use in which there might be gusts of wind.

The R92 is designed for close up use.

Dooley explains that the newer models are a bit more forgiving. "The 84 is quite well protected. We put puff shields on both sides of the ribbon. There was a later and earlier version of the (original RCA) 44 produced. The earlier version had puff shields, the later version had what were called 'damping screens.' We found that even though the things measured a little flatter on the bottom end with damping screens, people said they sounded better with the puff shields, so we make the older version."

Nevertheless, these are sensitive professional tools, deserving of care and respect in handling.

THE RIGHT MICROPHONE

On the vintage RCA 44's which can still be purchased for $3000 or more, Dooley waxes romantic, "It's said that if you put someone who can at least basically read – even if they're not a trained announcer – in front of an original 44, even the non-professional will begin to resemble professional talent."

As we mentioned earlier, Rick Dees has an R44 in his production studio. In a discussion with Dees that Dooley recounted, Wes brings home what we have said all along – the fact that you have to find what works for you and your station.

When Dees approached Dooley about adding more of the R44's for his on-air studio at KMVN-FM in Los Angeles, Dooley countered "You're running perfectly successfully with Sennheiser MD 421's (on air). I have a Rule of Thumb: If you're having success, why change anything?"

I certainly hope we are giving you some food for thought on microphones in these articles. The key point is that your microphones determine your "brand" as much as your jingles, liners, music, or personalities.

If you are happy with your sound, do not change the microphones. But if you are seeking a new sound or wanting to improve, listen, learn, and make wise and educated choices before spending substantial money on the sound of your station. I would love to hear about your success stories or challenges as you create your sound.

George Zahn is the Station Director at WMKV-FM in Cincinnati, OH. E-mail him at gzahn@lifesphere.org

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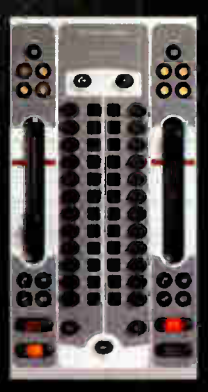

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EAS Guide

by Darryl Parker

Moving EAS into the 21st Century

After ten years of operation, the FCC has decided to bring the Emergency Alert System (EAS) up-to-date technologically and enhance the services available to emergency managers and broadcasters alike. With the inclusion of CAP (Common Alerting Protocol), it appears broadcasters may need new EAS boxes. Darryl Parker offers a look at what to expect as the Further Notice of Proposed Rule Making (FNPRM) works it way through the FCC and FEMA.

A "Review of the Emergency Alert System" is what the Federal Communications Commission adopted in their Second Report and Order (R&O) and Further Notice of Proposed Rulemaking recently. Broadcasters and Emergency Managers now have the opportunity to comment before details are locked down.

KEY PROVISIONS RAISE QUESTIONS

However, the NFPRM left many questions in its wake as it attempted to update the EAS with new technology and move the nation toward the Next Generation of EAS. The Report and Order is very long on concepts but often short on details.

Although the Commission would preserve the present EAS network, the most sweeping part of the R&O is a new requirement for EAS participants to "be able to receive CAP-formatted EAS alerts no later than 180 days after the Federal Emergency Management Agency (FEMA) published the technical standards and requirements for such FEMA transmissions." When will FEMA release the standards? As yet, no one knows for sure.

MORE NEW FEATURES

Furthermore, broadcasters and other EAS participants may be mandated in the future to receive and transmit state-level and geographically targeted EAS messages from state governors, and be able to receive CAP-formatted EAS alerts from other sources when FEMA adopts the specifications and message networks.

The requirement places the burden upon a state to have an approved state plan for delivery of those state-level messages, something presently missing in several areas of the country. Governors may designate others to issue messages on their behalf or such messages can be delivered by FEMA on behalf of a governor. Comments are sought on whether local entities should be allowed to issue certain mandatory alerts.

Additionally, wireline video providers join analog and digital radio, television broadcasters, direct broadcast satellite systems, and satellite digital audio radio systems in the class of EAS participants. The Commission also asked for more information and comments on what else might be done to make EAS more effective, particularly for non-English speakers and persons with disabilities.

THE CAP CONNECTION

Notably absent from the Commission's Report and Order were specifications for CAP-to-EAS conversion – that task was left to FEMA. (CAP protocol messages not only have the ability of delivering long text messages but can also be displayed as visual crawls or in closed captioning, avoiding an expensive and time consuming manual system.)

The biggest question of all is: *"Are EAS Participants required to have CAP decoders?"* The newly adopted Rule is vague and reads, *"... all EAS Participants must be able to receive CAP-formatted EAS alerts ..."* But the new Rule does not require each individual EAS Participant to install a CAP decoder.

In California and Hawaii CAP-to-EAS decoders are already being deployed at LP-1s and LP-2s but not at every station and cable operation. Stations and operators that monitor key EAS sources already receive EAS messages that were generated by CAP protocol in both these states. Does this mean that these subsequent stations "receive CAP-formatted EAS alerts"? This remains to be seen.

EAS DELIVERY

The FCC also wants to hear about is whether the current EAS web distribution structure with its two monitoring assignments should continue, or be replaced by alerts sent directly to each participant.

Not spelled out were the details of how state-level and geographically targeted EAS messages would be delivered to EAS participants. For example, the Internet might be used to deliver information; this could mean that every EAS participant must, in addition to monitoring two EAS sources, have an Internet connection as well. Other possible sources for message delivery include digital TV stations, satellites, and Part 74 signals.

One can only speculate as to the reasons, but the R&O discussed the needs of persons with disabilities and non-English speakers, yet left the details to the FNPRM. Usually, this is the Commission's way of asking individuals and organizations to provide information – electronically or on paper – with their comments and thoughts on these issues.

BEYOND SIMPLE MESSAGES

Most emergency managers specialize in structuring emergency information for public consumption but not necessarily in voicing that information for public broadcasts. Meteorologists have a similar problem; their areas of expertise do not always inlcude radio announcing.

Because the CAP protocol can contain a myriad of files and information, a CAP message could contain an audio file, e.g., .wav, .mp3, aes3, etc. The system can make text-to-speech (in English) translations, speeding delivery time. And it is technically possible to translate textural information from one language to another.

Such text-to-speech conversion will allow an emergency manager to sit at a keyboard and construct a text message for visual display and closed captioning – and an aural message that can be presented in the familiar EAS protocol. This will reduce the need for multiple "takes" of audio messages that often come with the pressure on an emergency manager of getting a message out to the public.

CAP AND FEMA

In addition to developing and publishing technical standards for reception of CAP-formatted EAS alerts by all EAS Participants, FEMA is to set the requirements for FEMA transmission of CAP messages. FEMA must also establish procedures by which EAS messages may be delivered via CAP on behalf of governors in states where there is no approved state plan.

Already some states such as California and Hawaii have CAP servers installed as a part of their emergency message origination and distribution systems. Broadcasters and cable operators benefit because, at certain locations, CAP messages are translated into EAS messages.

Not all states have such CAP servers nor plans for such servers, but FEMA will be the logical agency to organize the location, distribution, and installation of CAP servers. FEMA will also have to answer the question of whether CAP-to-EAS decoders will be required at every EAS participant's location or simply the ability to receive CAP originated messages delivered by the existing EAS network.

GEO-TARGETING WITH CAP

By the way, those CAP servers do not necessarily have to be deployed at state level. Metropolitan areas that span multiple states could have one or more CAP servers that share information with neighboring areas.

For example, EAS Participants in New York City would have to monitor stations in at least four other states in addition to their two FCC required monitoring assignments in order to receive all the emergency messages that could affect New York City.

A metropolitan server distributing emergency messages via CAP to EAS participants could greatly reduce the monitoring requirements and simultaneously distribute emergency messages more directly to their geographic targets, without the necessity for banks of receivers.

Connection to one CAP server network will also overcome some of the RF monitoring problems that stations encounter in trying to comply with current requirements. Sometimes in remote areas it is impossible to find two stations for monitoring. AM stations, necessary to the EAS web structure of distribution, sometimes cannot be received in noisy environments at distant locations, a fact that plagues the timely distribution of EAS messages.

POTENTIAL CONCERNS FOR BROADCASTERS

The new FCC requirements cannot mandate that FEMA accept any input from users (EAS participants) or the industry. In the adoption and promulgation of new standards FEMA could rely heavily upon their contractors who do not necessarily have experience with EAS or CAP.

If radically new standards are published by FEMA, it is possible that the industry would have to make sweeping changes in hardware and operations to comply. In the Second Report and Order there was no section on the financial impact to EAS participants – that was left open for comments in the Further Notice of Proposed Rulemaking.

FEMA, either in approval of individual state plans or in its own procedures, will have to decide how governors can designate others to use his/her authority to originate mandated messages. Could this power be construed to flow to a state agency? To county authorities? To municipal officials?

Overall, it is possible that FEMA could set procedures for distribution of emergency messages in states without approved EAS plans that could heavily impact the amount of capital required for compliance by EAS participants – a potential burden for small operators.

THE MATTER OF WHEN

Along with the question about hardware requirements, FEMA's timing is one of the top unanswered questions. Essentially EAS participants have 180 days after FEMA acts to comply with the new Rules.

If we look at the size of the task, we can estimate how long it will take. First, FEMA will have to gather information about CAP-to-EAS conversion, discuss, decide how specific the specifications will be, how rigidly they will be detailed, discuss again, and then publish the information. This part of the process alone could take several months.

Secondly, FEMA will have to delineate a network for distribution of CAP messages and select and designate CAP sites. Although this second part could progress in parallel with the first, it, too, will probably be several months long.

After these two steps are accomplished, FEMA will have to coordinate with other agencies in the Executive Branch, such as NOAA, FCC, FBI, and their parent, Homeland Security. This third part may take an additional period of months.

The shortest time that FEMA could accomplish its many tasks is probably on the order of 8 to 12 months, and could indeed stretch on much longer.

HARDWARE CHOICES

There are at least three approaches to new equipment that may be needed by EAS participants:

1) An interim solution that will decode CAP and generate an EAS message.

2) A CAP generator.

3) A new encoder/decoder that will incorporate both EAS and CAP.

The new Rules do not require EAS participants to be able to generate CAP protocol messages, only to receive them. Nevertheless, equipment is offered now from at least two sources to receive and process CAP protocol messages and generate EAS protocol messages that can be delivered to legacy EAS encoder/decoders and decoder-only units.

(Continued on Page 18)

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EAS Guide

by Darryl Parker

Continued from Page 16

These devices have the advantage of current availability in the marketplace but the disadvantage of perhaps not meeting the new, yet to be published FEMA specifications.

Another class of CAP converters can decode emergency messages not only to EAS protocol but also to other protocols suitable for graphics and text display.

The best example is a CAP converter that will take the long text field of a CAP message and translate it to a format that can be used by a character generator or closed caption generator. This type of converter will not be constrained to the current "assembly edit" process in EAS whereby EAS text is concatenated from EAS message fields, a process that does not contain a lot of the information conveyed by the audio portion of an EAS message.

CAP-ENHANCED CAPABILITIES

There are a number of "console" programs and tools that can be used to generate CAP protocol messages, which are basically XML computer files. These will no doubt be helpful to emergency managers but may not be required by EAS participants.

The third alternative is a new encoder/decoder that will decode and process both CAP protocol messages and EAS protocol messages, and deliver these messages to appropriate platforms to inform the public. New equipment can take advantage of new developments in technology, and will help define and dictate operation of new hardware.

Just think: when most EAS equipment was designed, standards for USB ports were just being developed. Internet connections were just coming of age. Upgrades of software-defined equipment were generally via EPROM, CD, or floppy.

With most EAS equipment approaching 12+ years of service, users are necessarily looking toward replacement. The dilemma becomes whether to replace it with equipment that has the same capabilities or with new gear using a new feature set, in keeping with the new Regulations.

PREDICTING EQUIPMENT COST

Without the requirements and specifications from FEMA, this is a moving target. It all depends upon the definitions. With EAS, we saw the importance of a single word in determining what hardware and software would be required.

Over the next 12 to 24 months, participants will need to watch for FEMA publication of specifications, monitor trade publications, and arrange to install any new necessary equipment in their technical plants and prepare for a period of testing to comply with new Rules.

The range could be from $0 if only limited CAP decoding is required to several thousands of dollars if every EAS participant must have CAP decoding capability.

The question that is begged along with the cost of any new equipment is: who will pay?

AN IMPORTANT TIME TO BE HEARD

The most important and immediate step that EAS participants should take is to file comments to the Further Notice of Proposed Rulemaking.

Participants should consider how they might receive CAP-originated EAS alerts. How will these alerts be presented to their viewers and listeners? Is it better to have the full, disruptive procedure of EAS alerts in order to inform the public of a particular emergency? What emergencies might lend themselves to a different on-air presentation? Could an announcer be given a script that was decoded from a CAP message? Could advisory emergency information be presented as a crawl that is periodically displayed for the viewer.

EAS participants need to consider how locally mandated alerts will effect their day-to-day operations. What officials will be able to send information via CAP to participants? How will that information be delivered to the public? When will that information be delivered to the public? How often will they "take over" your station?

State plans will play a key role in the future of how messages will be received, processed, and delivered. A participant needs to determine how these plans will be written and by whom. Authoring a plan will not only give states an advantage but also will give participants a say in how they will be administered.

TELL IT TO THE FCC!

The Commission will consider any discussion on the issues above, specifically including assessing EAS operation, the effects of mandating local official alerts, and addressing the needs of non-English speaking persons and persons with disabilities.

Comments can also be included on the economic impact of the new Rules and may be filed by any interested party on the FCC's Electronic Comment Filing System at http://fjallfoss.fcc.gov/ecfs/Upload/ The EAS FNPRM is in the middle of the list.

Be sure to make your voice heard on this issue of great importance to all broadcasters.

Darryl Parker is Senior Vice President of TFT Inc. in San Jose, CA. Contact Darryl at DParker@TFTInc.com

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Radio Guide Book Shelf

by Alan Alsobrook

Directional Antennas Made Simple, Second Edition

Author: Jack Layton

In the world of broadcast engineering today, one of the most misunderstood and feared things an engineer must work on is the directional AM antenna system (DA).

FINDING THE PATH

For many of the more senior Jedi Master engineers, DAs were something they grew up with and understood. On the other hand, it is not very often that greenhorns (anyone under 45 or so) have had much opportunity to work with the arrays. Consequently, they really have not been in a position to understand what makes them tick.

The best learning a younger engineer can have is guidance from an older engineer who is very comfortable working with AM antennas – and who takes the time to tell the apprentice what he is doing and why. Those opportunities just do not happen very often, leaving it up to the young Padawan to learn the "what to do's" and more importantly the "what not to do's" on their own.

Prior to 1996 there really were no easy reference guides for the new Padawans of AM engineering. Then Jack Layton published the first edition of *"Directional Antennas Made Simple."*

ON THE PATH

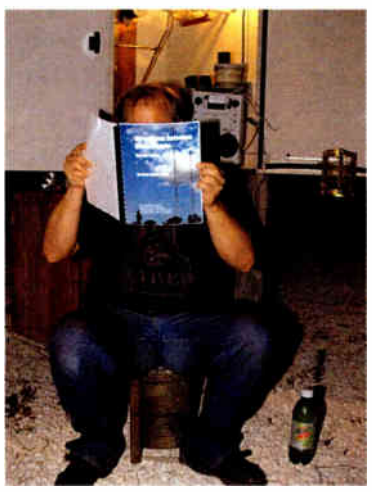
For those that obtained a copy, the book quickly became their primary reference source for all things antenna related.

Unfortunately, the title of the book may have thrown some people off from reading it, thinking: "Well, I do not have a directional so it is not going to help me." However, that definitely is *not* the case; Layton's book is an excellent learning tool for the entire AM transmission system, even if it is a non-directional station.

As the book starts off, the young Padawan is taught the ways of the force, and how to work with it. It progresses, teaching the apprentice the full power of the force and how to control and channel that power into a wonderful pattern of energy that will communicate with masses.

KNOWLEDGE

Chapter One starts by covering the single vertical antenna – and that sounds like a non-directional AM antenna to me! Layton goes into detail on all of the common tuning networks you would find in an Antenna Tuning Unit (ATU) and the reasons to use different networks in different situations. He also gives information on basic AM radiation characteristics, which one working with AM should understand.



The smart Padawan keeps his reference material close at hand.

As you follow along, you will see how you can put two or more vertical radiators together and form a directional system. In this edition, a section has been added covering the different radiation patterns and what they mean. You will also be presented with information on how the phases and ratios combine together to create a directional pattern.

With the basic theory in hand, it is time to discuss the requirements for building a directional array. Of course a non-directional station is simply a DA with only one tower; this means that the information is still relevant for those who are only planning to build a Non DA station.

RELEVANT INFORMATION

AM has become a hot topic today. For many years the construction of AM stations has been slow at best, now things are heating up. The FCC took in hundreds of new AM applications in the last filing window and is starting to trickle out the related construction permits.

Additionally, many stations are using a move to IBOC as a reason to upgrade or rebuild sites. So, you can see there will be quite a bit of AM station construction planned and implemented in the near future.

PROOF TIME

In Chapter Four, you learn how to do a non-directional Proof and properly document it for the FCC.

Doing a Proof for a directional station is often a very enjoyable task for engineers, but it is also a very time consuming and labor-intensive task. It is a highly expensive requirement that if done wrong would have to be done again. The book takes you carefully through the steps to make sure that your first Proof will be completed correctly.

Once you make it to Chapter Five, you should have the information to start tuning up an array for the first time. This chapter takes you step by step through the tune-up procedure.

This material is also invaluable should you ever have to correct an array that is out of tolerance. It can make the difference of weeks – perhaps even months – of work when trying to bring an array back into spec, once you understand how to tune up the array initially.

DA MAINTENANCE

Maintenance of the directional system is covered in Chapter Six. In this section the book covers different procedures used for preventive as well as corrective maintenance. All the reasons for when, why, and how you make a partial Proof-of-Performance are explained.

One of the very useful sections of this chapter is the procedure to relocate a monitor point. With all the development going on in some areas of the country, you could easily find one of your monitor points that was in the middle of a corn field three months ago is now center court of the new mall! When that happens you just know it is not going to work any more and you are going to have to move it.

The final section is on troubleshooting the sample system. Pay close attention to this section – the very first sentence is the most important one – which is summarized, "Don't try to fix it until you know what's broke!" Too many times a young Padawan has come in, noticed an antenna monitor reading that was out of tolerance, and immediately summoned the force to make a few adjustments on the phasor, only to later find out the problem was just a bad sample from Tower 2.

NEW MATERIAL

This Second Edition contains an added chapter: "Solutions to Unusual Problems." The unfortunate thing is that these "unusual problems" are often more usual than we would want them to be. The chapter covers such things as pass/reject networks, diplexors, detuning unintended radiators, special purpose power dividers, along with a real fun one: electrically reducing the height of a structure.

Finally the appendices will give you a bit of vector algebra review and understanding, along with reference materials on FCC Rules and mutual coupling.

Now that I have given you all this glowing information, it is only fair that I throw a bit of contrast on the subject. I noticed three areas that I thought could have been improved.

The first was the lack of any specific information on broadbanding for digital installations. Also, this book is still being bound (at least the copy I received) with the old style binding comb. I think one of the newer style combs that locks together and allows you to fold the book flat would be a nice improvement. Finally several typo's and wrong words have made it through the proofreading process and into the final print. However, I can understand how that could happen, as I think this magazine's editor usually goes cross-eyed for a few days after I turn in an article.

In closing, to all the young Padawans out there: this book is a must have if you have to do any work on an AM station.

Jack Layton self-publishes Directional Antennas Made Simple. You can order the book directly from Layton for $59.95, plus $4.00 shipping at layton2@earthlink.net and on-line at amazon.com or the NAB Bookstore

Alan Alsobrook is a frequent contributor to ***Radio Guide*** *when he is not at the movies. A contract engineer and ABIP Inspector for the state of Florida, Alan's email is: aalso@bellsouth.net*

The Worst I've Ever Seen

A Visual Display of the Good, the Bad, and the Plain Hard-to-Believe

What's Wrong with This Picture?

Last month's picture of the interior of a transmitter site brought us some interesting comments via email. In addition to the points made by John Stortz, several of you let us know about a few other "issues" that you saw; some easily correctable, some "built-in" from the original construction of a site.

A SECOND OPINION IS ALWAYS GOOD

Among other things, the comments received show that it is never a bad idea to have another engineer take a look at your site. That fresh look will often catch things you missed.

For example, one reader noticed the shelf in front of the rack, into which a site visitor might walk unexpectedly. While the angle of the picture makes it a bit worse than it is, such "protrusions" into the pathway might be worth attention. Perhaps something as simple as a piece of bright colored plastic could be affixed to the shelf to both visually alert individuals and smooth out the pointed corner.

Another reader pointed out the outside light visible at the door jam, noting that more than light can get through the gap, resulting in unwanted visitors like scorpions, etc.

A FRESH LOOK

A picture like this is also a good way for the resident engineer to "see" things in a different perspective. And, after taking a fresh look, John also noticed the light leakage.

He notes: "*That* needs to get checked on the next visit! You can see the floor looks kind of dirty, near the door and the power supply.

WHAT DO YOU SEE?

Another interesting site is shown here. Only, this time, we will ask you, "What is wrong with this picture?"

Since the idea is to learn from one another – not to cause problems for anyone – sites like this will not be identified unless the sender wishes so. We invite you to send in your pictures of sites with "issues" – anonymously, if necessary. Send to editor@radio-guide.com

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Tech Tips

by Dave Joseph

A Quick and Easy Way to Get a Visual Check on Things

Sometimes things just fall into place and help keep you ahead of the game.

I have several television stations under my care; all but one are remote satellite-fed sites. As several of the stations are too far away to receive directly, I use a Slingbox to check and verify if the station is on the air. (The tuner capability of the Slingbox – with a paper clip stuck into the antenna input – makes it easy to ensure the station is actually on the air!)

GETTING MORE DATA

Recently, there have been some issues with the satellite receiver signal levels. So I needed a way to be able to actually see those signal levels on the receiver's display whenever I wanted.

During my weekly stroll through one of the veteran electronic surplus houses in the area, I spied some webcams on sale. Looking at them, I thought "why not use something like this to look at the receiver display." However, I did not immediately buy one as I wanted to check on webcam services, availability, and cost.

I searched for "webcams" on the web and came up with several free services. It did not have to be fancy, just give me a picture on demand. I settled on mycampage.com (a big plus was the absence of porn-filled "selected sites" being featured there!).

QUICK START

It only took a few minutes to sign up and get a site from home up and running. I used one of my digital cameras as a webcam to check it out.

The next day, while I was in the local drugstore, I spied a tiny keychain camera on a blisterpack, hanging by the cash register. I grabbed one and checked to see if it would also work as a webcam; it said it did. At home, I hooked it up to the webcam application and it worked just fine. In fact, these tiny cameras (at $15, not a great picture) also focused pretty close. Since I was going to use it up close, the resolution did not have to be real clean.

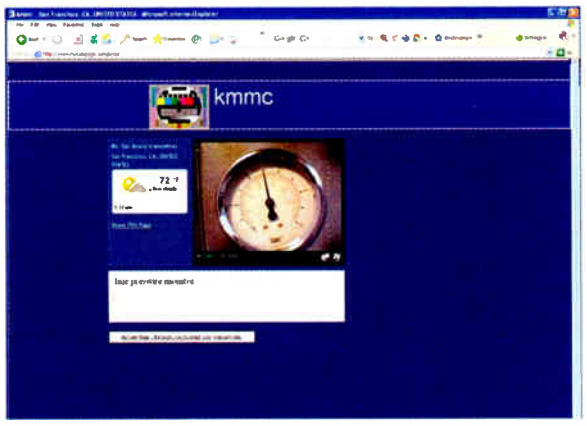
So – off to the site with the camera and a laptop. In minutes I had an account set up and was streaming video online. Now, anytime I want to check on anything I would like to look at, at any of my sites where I have a webcam running, it is simple to do.

DIFFERENT PROBLEM, SAME SOLUTION

Not long after my signal level issue was resolved, the dehydrator at one of my sites developed regulator problems. The pressure level should be five psi, but the regulator was waffling between two and three pounds.

I ordered a replacement, but needed to keep an eye on the pressure. Since I did not think the pump in the dehydrator was designed for 24/7 operation, being able to do a visual check whenever I had access to the Internet would be a real plus.

Fortunately, as it turned out, the pump held up for a little over two weeks of continuous running. The dehydrator is now fixed and the line is back up to five psi and holding.



A reassuring reading available – anytime, anywhere via Internet.

DO IT YOURSELF

If you need to check or keep an eye on something – or are just curious – and have Internet connectivity, a webcam with one of the free services available is an easy way to do it.

The basic requirements are an Internet connection, a computer to run the application from the webcam service, and some sort of webcam – any digital camera with a webcam function and application program will do. Of course, depending upon your OS there may be multiple variables. For example, I find I need to restart my XP system at least once a week.

For those of us who have remote sites, I have found this to be a great tool!

Dave Joseph is a radio and TV contract engineer, in Central Californina, primarily in the San Francisco Bay area. Contact Dave at w7amx@hotmail.com

Send your tech tips to: editor@radio-guide.com

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Heavy Metal

WLW's 500 kW Transmitter – Reaching for Just Another 10 dB

by Paul Jellison

My kids grew up in a most unusual home. For 13 years my family lived at the WLW transmitter site in Mason, Ohio. Well known by those in the local community as a historical landmark, it was always easy to find the way home or get a pizza delivered with that big tower in the front yard.

But it is something inside the transmitter building that to this day never fails to awe visitors – over 60 years since its voice was last heard. I refer to the remaining sections of WLW's great 500 kilowatt, superpower transmitter.

A BROADCAST LEADER

WLW started its broadcasting life in Cincinnati, Ohio in 1922. It was first, or a leader, in many areas of broadcasting performances and technology of the day. But it is likely best known in broadcast technical circles for becoming the only station in the United States to ever operate in the Medium Wave band with 500 kilowatts of transmitter power.

In the early days of broadcasting it was not uncommon for a radio receiver to cost several hundreds of dollars (200 dollars in 1920 was the equivalent of 2,250 dollars today). Obviously that was a lot of money. If the medium was to take off receivers certainly had to be more attainable for the average consumer.

WLW's owner, Powel Crosley was credited with developing economical radios for the masses. He very quickly learned that for the public to be able to comfortably receive a station's signal either the receiver would have to be very sensitive or the transmitted signal would have to be very strong.

CRANKING UP THE POWER

Since there were only so many things that could be done to make an economical receiver, Crosley and his engineers focused their energy on increasing the transmitted power of the radio station. WLW made several 10 dB jumps in power. From 500 Watts to 5 kW, and then 50 kW.

WLW began 50 kW operations in 1928 using a Western Electric Model 7A transmitter. This transmitter remains at the WLW transmitter site to this day – and was operated on the air as recently as January 1, 2000.

The 1928 Western Electric Model 7A.

But even 50 kW was not enough for Crosley. 500 kW seemed the logical next level. Armed with a permit to be the only station operating on their channel in the United States, known as a Clear Channel authorization, they sought the next 10 dB level of power. Finally, the new FCC did grant WLW a permit to operate at 500 kW.

BUILDING THE TRANSMITTER

WLW was operating its Western Electric transmitter and a flat top antenna at its current location in Mason, Ohio. When it was decided to make the jump to 500 kW a total redesign of the station was in order.

This was not just a transmitter upsize – it was a total rebuild. In the 1930's, a transmitter of this size was not a catalog item – it was a one-off custom device. Crosley Corporation contracted with RCA to direct this undertaking. RCA in turn contracted with Westinghouse and GE.

Thus, the big three of the day were all involved. RCA was the general contractor handling design and oversight. Westinghouse provided the transformers, or "iron," for the rig and GE did the controls and RF circuitry, which was quite involved for a transmitter of that size.

POWEL CROSLEY'S MASTERPIECE

Speaking of size, this transmitter occupied two floors of an addition, roughly 60 X 35 feet, in the already spacious 50 kW plant. There was plenty of space to hold everything.

The top floor of the building housed three RF cabinets, two modulation cabinets, and one AC rectification and control cabinet. Down in the basement were housed the modulation transformers, RF harmonic filter assembly, power supply oil circuit breakers, filter capacitor banks, DC bias generators, and DC filament generators. The power transformers were located in the rear of the building.

Each RF section was combined in series and could operate independently through a rather complex switching and control arrangement, in case of a failure in one of the cabinets. Similarly the two modulator sections could be operated independently.

Since the Western Electric 50 kW transmitter became the RF driver for the larger 500 kW rig, the low level RF oscillators, drivers and amplification were not recreated. This has led some to believe that the 500 kW transmitter was just a linear amplifier.

(Continued on Page 28)

Heavy Metal

by Paul Jellison

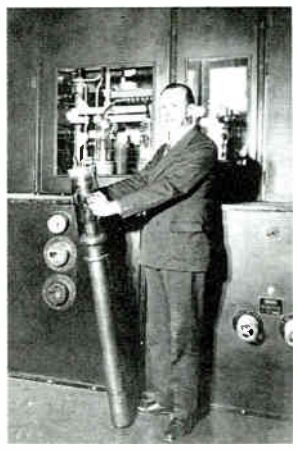
Continued From Page 26

That was certainly not the case – the Western Electric rig was just a convenient source of RF drive. No audio was applied to the 50 kW rig during the operation of the 500 kW transmitter. Audio on the 500 kW rig was applied to its own modulators. AC rectification was handled by a bank of rather large rectifiers that could be fickle if not given the proper warm-up times

The 500 kW transmitter in operation.

Though several tubes types were used in both modulator and RF sections of the transmitter, the UV-862 was used most continuously through out the life of the transmitter.

The station used no limiting on the audio and, as a result, the transmitter would drop off when an errant cough or overly loud passage made it past all the operators on duty. (This usually consisted of a studio engineer and a transmitter engineer just massaging the audio levels – and adds a new meaning to "watch your levels.") Today this seems unthinkable but that was the state of the art in 1934.



One of the UV-862 tubes, held by Powel Crosley.

A WHOLE LOT OF POWER

The transmitter was the biggest ever built up until that time. Even the electrical power system had to be beefed up because the power demands placed on the grid were pretty significant.

A three-phase substation was constructed that was capable of supplying a 2-Megawatt load. The primary voltage ran 33.5 kV; the secondary voltage feeding the building and the transmitters was 2300 Volts, later raised to 2400 Volts after a primary voltage increase. The site was operated into the early 1990's with 2400 Volts as the primary building operating voltage. At that time it was converted to a more standard 480 Volt operation.

If there was a fault in the rectifiers the whole community knew it. As the fault pulled heavy currents from the grid the electric grid, the grid would cause lights to blink in homes and businesses around the transmitter site.

There were stories of lightning strikes on the tower causing a blue light show on the tower's guy insulators. This went on utill an operator killed the RF, allowing the arc to extinguish – automatic protection did not come utill later.

... AND A LOT OF WATER

The 500 kW transmitter was water cooled, as was the 50 kW Western Electric transmitter. Again, the cooling system had to be beefed up to handle the extra energy needing dissipated. A spray cooling pond was created that dissipated the waste heat from the transmitter.

WLW's cooling pond was used to dissipate a lot of heat.

The concrete pond was roughly 70 feet by 70 feet, divided into two halves. This way the transmitter could be operated on just one half of the pond while the other half was undergoing maintenance. Inside were four pumps. Two iron pumps circulated water to the outside pond system and two bronze pumps operated the inside closed-loop system. Dual pumps with the proper valve configuration added a level of redundancy so the transmitter could remain operational while maintenance was preformed.

The inside system used distilled water so contamination in the system would not cause problems with stray currents to ground. (With the voltage potential in the transmitter being 11,500 Volts DC, any stray resistance in the water cooling system could cause serious problems.) Heat transfer from the inside loop to the outside loop was accomplished through a heat exchanger.

REACHING OUT TO THE LISTENERS

To get the RF from the transmitter to the tower, a 10-inch diameter, 100 Ohm coaxial transmission line was built on site. It had an aluminum outer and copper inner conductor.

A brick ATU building was constructed, and housed an ATU capable of handling the massive currents and voltages present for 500 kW operations. The ATU, in turn, fed a new, 827-foot cantilevered, guyed tower built specifically by Blaw-Knox to handle the extra power generated during 500 kW operations. *(Continued on Page 30)*

Heavy Metal

by Paul Jellison

Continued From Page 28

The tower was visible for miles, and came to well represent the enhanced reach of the station.

Interestingly, the tower's unique design led many to believe it was two self-supporting towers stacked back to back with the bottom one upside down. That is definitely not the case. It was designed specifically for this application.

A POWERFUL DECADE

This behemoth ran from the mid-1930's through WWII. But it was ultimately killed, not by technical nor financial reasons, but by the politics of the day – and those politics were the eventual downfall of all superpower broadcasting in the United States.

In the early 1940s, there were many voices clamoring for their slice of the RF spectrum. Viable FM and TV service were still in the future, so the number of radio channels was very limited.

Politicians bowed to the pressure for more radio stations. It was felt that to allow a handful of superpower stations to dominate the AM band would be a disservice to the public. Thus, WLW's authority to operate was not renewed, and no more 500 kW stations ever came to the air in the United States.

THE END OF SUPERPOWER HOPES

In the 1960's a half-hearted push was made to operate at superpower levels once again. It was felt that by retrofitting the old RCA transmitter with modern ceramic tubes, 625 kW of power could be generated and modulated properly.

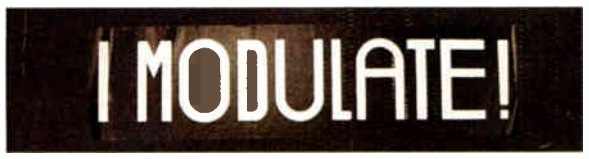
The transmitter was maintained by the transmitter staff up to that point. But ultimately the clear channels were subdivided to allow new stations to operate on those once exclusive slices of spectrum. The hope of ever operating it again were dashed – and the superpower era was truly gone.

THE NATION'S STATION

I feel I was the steward of a piece of history that has seen many innovations through the years. I added my contributions and am sure there are more to come.

When I first came to work for WLW the sense of history at the site was awesome. It was interesting to research and discover more over the years. My father and other old timers used to tell me stories of listening to WLW many miles distant. And their stories were very personal. WLW was invited into many peoples lives daily. For them to have recalled these memories over fifty years later tells me their impact was significant. I wonder how many people will recall what they have heard today.

WLW has seen a lot of history. However it is still a vibrant and very successful modern day radio station. I was glad to have added my name to the Log Book.



Paul Jellison is a Regional Vice President of Engineering for Clear Channel Radio. Based in Wilmington, OH, he can be contacted at pauljellison@clearchannel.com

Crosley

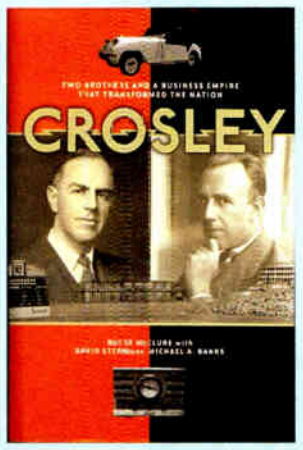
Two Brothers and a Business Empire That Transformed the Nation

By Jeff Johnson

Powel Crosley Jr.'s dream was to be an automobile magnate. He had a fascination with all things mechanical from his earliest days, especially cars. It is ironic that Crosley, one of the most successful industrialists of the first half of the twentieth century, realized great success, but not the success he dreamed of.

Probably best known among broadcasters for WLW and its 500 kW transmitter – on the air in the 1930's and early 1940's – Crosley had great success designing, manufacturing, and marketing consumer products "for the masses, not the classes." He realized that the more powerful a broadcast station was, the less expensive a receiver could be. Selling radios was his goal – and more power was his means.

A recently published book, *Crosley*, recounts the story of the Cincinnati Crosley family and the brothers Powel, Jr. and Lewis Crosley. Powel was the dreamer and Lewis the facilitator. The book was co-authored by Rusty McClure, a grandson of Lewis and the sole direct descendent of the Crosley brothers.



Early in the 1920's radio was an exciting new phenomenon. "On the afternoon of February 21, 1921, two members of the increasingly curious general public walked into a store and straight in to history," wrote Rusty McClure. The store was Precision Equipment in Cincinnati and the customers were Powel, Jr. and Powel Crosley, III, his son. There they found that a radio cost a hundred and thirty dollars for a one tube set – unaffordable. They did walk out with a twenty-five-cent pamphlet called *The A. B. C. of Radio*. They would build their own.

Crosley tells the story of building that first radio through to the culminating achievement, the 500 kW WLW broadcasting plant in Mason, Ohio. It also tells of the development of other innovations "for the masses, not the classes," such as the Shelvador refrigerator, the Icy Ball non-electric chiller, and, yes, the Crosley automobile.

Crosley, written by Rusty McClure, with David Stern and Michael A. Banks. Clerisy Press, Cincinnati, Ohio, 2006

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FCC Focus

by Jeff Johnson

FAA Outsourced NOTAM Reporting

Among the more frequent violations that get stations into trouble with the FCC, is the failure to report and/or promptly correct problems with tower lighting or painting. Furthermore, recent changes in the reporting system, now contracted outside the FAA, make it worthwhile for station engineers to review procedures, phone numbers, and logging requirements.

From the perspective of the broadcaster it is vitally important to follow the Rules set down by the Federal Communications Commission – the FCC. Disregarding or downplaying the importance of those Rules may result in heavy fines, or worse – loss of the station's broadcast license.

Aside from merely following the Rules, ensuring that tower lighting is operating properly is a safety issue. A dark tower could invite a collision, destroying the tower and, more importantly, taking lives.

TOWER LIGHTS

When the FCC Radio Inspectors visit, a particular focus of their inspection is the proper operation, maintenance, notification, and logging of matters pertaining to tower lights.

In order to satisfy the FCC, should a beacon (flashing lamp) or other top light fail, that failure must be logged and also reported to the Federal Aviation Administration. The FAA will then issue a Notice to Airmen (NOTAM), warning them of the outage. This is detailed in Part 17.48 of the FCC Rules.

> ***Sec. 17.48* Notification of extinguishment or improper functioning of lights.**
>
> *The owner of any antenna structure which is registered with the Commission and has been assigned lighting specifications referenced in this part:*
>
> *(a) Shall report immediately by telephone or telegraph to the nearest Flight Service Station or office of the Federal Aviation Administration* ***any observed or otherwise known extinguishment or improper functioning of any top steady burning light or any flashing obstruction light, regardless of its position on the antenna structure, not corrected within 30 minutes. Such reports shall set forth the condition of the light or lights, the circumstances which caused the failure, the probable date for restoration of service, the FCC Antenna Structure Registration Number, the height of the structure (AGL and AMSL if known) and the name, title, address, and telephone number of the person making the report.*** *Further notification by telephone or telegraph shall be given immediately upon resumption of normal operation of the light or lights.*
>
> *(b) An extinguishment or improper functioning of a steady burning side intermediate light or lights, shall be corrected as soon as possible, but notification to the FAA of such extinguishment or improper functioning is not required.*

All of this seems pretty straightforward, but some broadcasters have noted a dilemma of answerability to two government agencies – the FCC and the FAA – each with different agenda. There is also confusion concerning the takeover of the FAA NOTAM function by an outside corporation.

WHO IS ON THE LINE

In the past, a call would be made to the Flight Service Station (FSS) closest to the tower affected. This is no longer true. Lockheed Martin Corporation has been taking over the Flight Service Stations from the FAA. Recently, ***Radio Guide*** spoke with Tammy L. Jones, Public Affairs Specialist with the Office of Communications at the FAA. She agreed to address our questions.

Radio Guide: "Ms. Jones, what was the reasoning behind this decision to outsource the Flight Service Stations, how it is being implemented, and how does it affect broadcasters?"

Tammy Jones: "The FAA awarded a contract to Lockheed Martin for the services [previously] performed by the FAA's flight services within the continental United States, Hawaii and Puerto Rico through a public-private competitive process. Lockheed has operated these Flight Service Stations since October of 2005.

"Tower light outage Notices to Airmen (NOTAMs) are handled in the same manner as they were prior to the contract award and in accordance with FAA Order 7930.2K. No changes were made to [these] operating procedures."

(Editors note: The entire text of the current version of the FAA Order 7930.2K is dated August 30, 2007, and is available on the FAA's Internet website at: http://www.faa.gov/airports_airtraffic/air_traffic/publications/atpubs/ntm/)

THE NUMBER IN NEW YORK IS:

Radio Guide: "When reporting a lighting problem, should all broadcasters always call the same number now? And, if the local FSS has not yet been transitioned is it acceptable to call the local number we used to use?"

Tammy Jones: "Yes, all broadcasters should use the same number now for those locations already transitioned to Lockheed Flight Service for the 21st Century Operations (FS21). The number is 1-877-4-US-NTMS or **1-877-487-6867**.

"Four sites have yet to be transitioned: Bridgeport, Cleveland, San Juan and Islip. Broadcasters should continue to use the telephone numbers they previously used for those four sites until they are transitioned. *All sites will be transitioned by the end of this calendar year."*

Radio Guide: "How should a request for a NOTAM be made? What information should be supplied? Should we assume the Antenna Structure Registration (ASR) is always required?"

Tammy Jones: "Yes, the ASR number is always required plus any other information needed by the specialist to process the NOTAM."

(Continued on Page 34)

FCC Focus

by Jeff Johnson

Continued from Page 32

THE LOGGING PROBLEM

One of the problems reported by a number of broadcast engineers is a growing reluctance of the FSS employee contacted to accept the engineer's information, issue a NOTAM number, and give his or her initials to the engineer. This seems to be contrary to Section 4.1.1 of the FAA Order7930.2K.

4-1-1. Accepting NOTAM Iinformation

FSS facilities shall accept and document all aeronautical information regardless of source, provided the occurrence is no more than 3 days in the future. Information from other-than-authorized authorities shall be verified prior to NOTAM issuance.

Radio Guide: "The FCC requires that details of calls to FSSs be entered in the station's log, in case any questions arise later. What should the reporting person do if the FSS employee refuses to give an incident number or his initials?"

Tammy Jones: "If the employee refuses to give his/her initials, the engineer should ask to be transferred to a supervisor.

NOTAM CRITERIA

Radio Guide: "Are the FAA's parameters requiring a beacon outage NOTAM the same as the FCC's? There are reports of refusal to issue a NOTAM for anything less critical than a complete tower lighting or top beacon failure."

Tammy Jones: "Lockheed Martin parameters for issuing beacon outage NOTAMs are dictated by FAA Order 7930.2K. Operator guidance for FAA notification of tower light outages or improper functioning of lights can be found in CFR 47 section 17.48 (part of the FCC Rules; see above). You can obtain these orders and other information from the FAA website at www.faa.gov"

FAA Order 7930.2K – Section 2. NOTAMS Lighting Aid

5-2-1. General

a. Originate NOTAMs concerning conditions of lighting aids you are responsible for controlling or monitoring.

b. Report outages or irregular operations of all lighting aids within your flight plan area. Conditions requiring a NOTAM should be coordinated with the appropriate air traffic facilities.

c. *Commercial operators are required to report the improper functioning of any obstruction light or lights by telephone to the nearest flight service station or office of the FAA.* (Emphasis added) Reporting the operating status of other types of obstruction lights is the responsibility of the operator. Reference - 47 CFR Section 17.48.

d. The following information is required when reports are received concerning an obstruction light outage:

1. Height of the obstruction in MSL (if known) and AGL. (Examples omitted)

2. Location in nautical miles and 16 points of the compass from the nearest airport.

3. Name, title (if appropriate), and telephone number of the person making the report.

4. When possible, name, title (if appropriate), and telephone number of person responsible for the obstruction lights if other than subpara d3, above.

5. Return-to-service time. See subpara 5-2-2d11(d).

[5.2.2d11(d): When a notice of light outage is received without a return-to-service time, inform the sponsor that you will be adding 15 days to the current time for the return-to-service time, at which time the NOTAM will be auto canceled. Advise the sponsor that any return-to-service time earlier than the 15 days shall be called in immediately.]

6. Antenna structure registration number (ASR) see subpara 5-2-2d11(e).

[5.2.2d11(e): When an obstruction light outage NOTAM is auto canceled after 15 days, the canceled NOTAM, including the tower number/ASR number (antenna structure registration number), will be faxed to the appropriate FCC field office. The ASR number shall be obtained from the sponsor when the outage is called in, and will be put in the text of the NOTAM]

5-2-3. NOTAM (L) LIGHTING AIDS

a. Any obstruction 200 feet AGL or less and more than 5-statute miles from a public-use airport does not constitute a hazard.

GETTING THE WORD OUT

Radio Guide: "Ms. Jones, could you outline the procedures taken by the FAA once a NOTAM has been issued by the FAA? How quickly would a pilot flying near the tower involved become aware of the hazard?"

Tammy Jones: "Upon receipt of NOTAM information, the flight service specialist enters it into the US NOTAM System (USNS) database via FS21. NOTAM data is available almost immediately for use by flight service specialists and others who have access to the USNS database. Flight Services also notifies the appropriate Air Traffic Control facilities of the outage and duration."

Radio Guide: "Thank you for your courtesy to our readers. This information will contribute to the safety of all."

REFERENCES

Lockheed Martin maintains a website at this link: www.afss.com/

Published NOTAMs are available at this link: http://www.faa.gov/airports_airtraffic/air_traffic/publications/notices/

The Aircraft Owners and Pilots Association (AOPA) provides this information on the new FSS system: http://www.aopa.org/whatsnew/air_traffic/a76_process.html

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Jeff Johnson is a regular contributor to ***Radio Guide****. Contact Jeff at jeff@rfproof.com*

DSPXtreme
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Extreme PROCESSING

The DSPXtreme is the newest addition to BW Broadcast's DSPX range of audio processors and we've included a few new features you wouldn't normally expect in an audio processor.

The first thing you will notice is the 2RU form factor which now includes two colour screens - one of which is touch sensitive. As well as looking great, the touch screen removes the need for jogwheels, joysticks and buttons allowing you to navigate, setup and control the DSPXtreme with a touch of your finger.

Behind the stylish front panel you'll find we've included more of the features that have made the DSPX range of processors among the best in the world. If you don't need all the features, no problem, the DSPXtreme is available in four different versions with tailored hardware and programming features: FM, AM, CD, HD.

For quality FM stereo broadcasting, the DSPXtreme-FM includes the world class stereo encoder found in the DSPX and DSPXtra. As well as the standard processing features you'd expect in a top-line processor, the DSPXtreme-FM has dual output paths allowing HD and FM services to be processed simultaneously without compromise. Simulcasting of FM and HD service is not a problem using the diversity delay feature.

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Remote configuration and monitoring is simple with numerous connectivity options. These include an Ethernet port for LAN or WAN access, an RS232 serial port and an 802.11 (WIFI) Wireless interface. If you don't require a full user interface a remote trigger port is available that allows preset selection through contact closures.

You want more? No problem. The DSPXtreme has a flexible 'flash' upgradeable architecture which means that as we continue to make enhancements and add features, you can continue to reap the rewards. You can simply download the upgrades from our website.

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BW BROADCAST

IT Guide

by Steve Lewis

Battling Malware Infections

Firewalls – both hardware and software – anti-virus software and anti-spyware software form a key line of defense in protecting the computers within your domain (both physical and virtual), whether it is just in the engineering department or the entire building.

But what happens – and what can you do – if some malware gets through your defenses, whether "assisted" by staff or not? For many situations, the question actually is not if, but *when* it happens.

TIME TO ACT

Usually, it starts with an urgent call from someone who complains that their computer keeps restarting, or the keys are messed up, or they have been notified by somebody who received a virus warning after opening an email sent to them by the caller. What to do?

Step 1: "Don't Panic!" The transmitter is still on the air. The computer problem is relatively minor.

Step 2: As quickly as possible, disconnect from the network any machine suspected of being infected. Since you have no clear idea at this point what you are dealing with nor how this particular machine was infected or if it might try to infect other machines, it is best to be safe rather than sorry – sorry being a dozen calls later in the day reporting a similar problem.

USE THE RIGHT TOOLS

How you proceed at this point depends on the tools already installed on the machine. Anti-virus software and a good spyware detection program are absolute musts at this point. If the box has both, proceed to step 5. If not, this is the time to install them.

Step 3: If the machine will boot up, install an anti-virus program and spyware detector. You have choices at this point. Use an anti-virus licensed to your company or proceed to download from another computer – *not the infected box* – a trial version of Norton, Kapersky, AVG or similar programs. Burn the download to a CDR.

Repeat this process for anti-spyware. Ad Aware is a good choice. Spybot Search and Destroy would be a good idea. Again, burn them to a CD.

Step 4: Take the CD to the infected machine and install the software. If everything has gone smoothly to this point, you are ready to scan. Depending on how badly hosed the machine is, you may need to troubleshoot your installs – some malware will at least attempt you from installing and/or running the detection software.

FINDING THE PROBLEM

Step 5: Scan the infected machine with the anti-virus software first. Depending on the amount of data stored, this process could take from a few minutes to an hour or more to complete. Remove (or at least quarantine) any files that are believed to contain a virus.

Step 6: Repeat this process with the anti-spyware programs. As a general rule, these scans do not take nearly as long. If you have more than one anti-spyware program on the machine, repeat the scan using the other program(s).

CLEANING UP

Some malware can be fixed or deleted without harm to the operating system or applications while others will be more difficult and prove to be a severe problem.

Your first test of success will be to reboot the system (while still disconnected from the network) and find out if it will run "correctly" after your scanning has been completed. If it appears that all is OK, then *immediately* back up all important data files (spreadsheets, word processing files, etc.) to writable CD or DVD disks. This is protection in case the problem re-appears.

As an absolute last resort, connect the machine to the network and transfer files to a safe location. Disconnect from the network again.

TEST THE SYSTEM

If the scans detected problems and you believe that these problems have been fixed, conduct a few more tests with the application first thought to have caused the problem. If the problem seems to be related to mail exchange, you will have to connect to the network and find a willing soul with whom you can exchange a few messages.

If you are not satisfied that the problem(s) have been resolved, then there is but one final step: reload the operating system, let it patch until it is current, and then reload your application software. Remember that backup I mentioned a couple of paragraphs ago? This is the time to load it back to the computer. Oh, and do not forget to re-install virus and spyware protection.

As is obvious, the steps presented here are very generic. As your scans find problems and list the names of the virus or spyware it has found, write those names down. You can then Google for those names and find out more about what was affected, and possibly find specific steps to deal with the infection.

Steve Lewis has moved from announcing and engineering to IT Manager and back. Contact Steve at mswmv@myvb.net

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Jampro HD Radio Antenna Pays Off for WFCJ-FM

by John Graham

A space-combined HD Radio implementation was found to be an ideal upgrade for increasing this station's success and presence among its listeners. It was also the most economical solution for the non-profit religious broadcaster.

WFCJ-FM is a 50 kW 501c3 non-profit station broadcasting religious music and teaching to the greater Dayton, Ohio market. As such, we are limited regarding how many commercials and paid programs we air.

For three days at the beginning of every October, we run spots to encourage donations from satisfied listeners. Donations are vital to us because they represent about one-third of our yearly operating budget. They also confirm that our listeners like what they are hearing.

A major promise of digital transmission is being able to do multiple channel of programming. With this capability, we could satisfy more listeners, which would result in increased support.

TIME FOR DIGITAL

Early in 2006, we began to get serious about digital transmission. Dayton was one of the 28 markets that began to rollout HD Radio, and we began to see that larger stations like those of Clear Channel were going HD. At that time it was experimental. Licensing requirements were lower and it was less expensive than it is now. However, we did not plan to go HD that early.

With the FCC Regulations that came out last March, it became no longer experimental. We saw an opportunity to multicast and add a new, all-music HD-2 broadcast channel. An Internet feed with our main HD-1 channel was also planned.

We were already using praise and worship music programming that we received by satellite from Salem Communications for overnights on our analog transmission, but were not using that content for the rest of the day. For HD-2, we thought we could just add another computer, take advantage of Salem's programming, mix it with our programming, and feed it to the new HD-2 channel.

INEXPENSIVE AND PAINLESS TRANSITION

We have always constantly upgraded the station. We started moving toward HD a few years ago by installing Logitech router consoles for our Air, Production, and Newsroom. New servers and Audio Vault automation workstations from Broadcast Electronics were also installed.

Clair Miller, our Vice President and General Manager often reminds me, "Don't go cheap and undercut yourself; get good equipment that is going to last a long time." Over that last 24 years at WFCJ, I have learned that is good advice. I have also learned that the more research you do and the earlier you plan, the better and less expensive new systems can be.

The transition to HD was relatively painless. It was much less expensive than we originally thought, and we did not have to sacrifice quality or reliability by going with inferior grade equipment. In fact, we now have true reliability with redundant backup transmission.

THE SPACE-COMBINED SOLUTION

Of course, we could have gone HD by increasing the power on our main transmitter, adding a high-level combiner, and using our main six-bay antenna for the HD. Our transmitter could have handled the power increase, but doing that and buying the combiner and associated dummy load was very expensive. That route also meant a higher heat load, greater power consumption and more space taken up in the already crowded transmitter room.

The idea of using a secondary antenna and space-combining was very appealing. We only needed a small antenna to handle 500 watts, so I put a call into Jampro Antennas in California. They were very helpful and recommended their JLST model two-bay.

The JLST is a circularly polarized, low-power FM antenna designed specifically for omni-directional translator/booster application, and it was rated at 500 watts maximum input. The antenna is made of stainless steel and hot-dipped galvanized steel. It seemed ideal for our HD application and it was surprisingly inexpensive.

The JLST antenna as received.

QUICK INSTALL

Jampro put us in touch with Rick Funk at RF Specialties. Rick helped us with the design and engineering. He noticed we had an abandoned 7/8-inch transmission line on our tower. Since Miami Valley Christian Broadcasting owns both WFCJ and the tower, we used that transmission line and saved some money.

We ordered the JLST and Jampro shipped the two-bay antenna mounted on a 15-foot pole. With all the hardware to bolt the assembly to the tower, it was ready for side mounting. We mounted the JLST at 460 feet, about 100 feet lower than our main antenna. Installation only took a few hours.

Used in concert with our existing main six-bay dipole antenna, we are very pleased with the results of going HD with the Jampro space-combined JLST. Technically, we have had very few problems since we fired-up the HD. It has been performing excellently.

The antenna being hoisted to its mounting position.

EXCELLENT PERFORMANCE

The HD coverage has also exceeded our expectations. The signal is clean 25 to 35 miles out from our tower, depending on the terrain. I monitored the signal with my car, equipped with a Boston Acoustics receiver. Even while using a somewhat mismatched antenna, the signal quality was great.

From Dayton, we reach from the northern part of Cincinnati over to the Ohio-Indiana border, which is 35 miles away. We can be received in HD 25 to 30 miles to the east and the southeast, where we are short-spaced with another station. We can be heard in Wilmington, Ohio, about 35 miles away. Even with only 477 watts of power, our HD signal generally covers most of our 60-dBu analog signal area.

At no sacrifice in signal quality, we estimate we saved about $20,000.00 by going with the space-combined Jampro in comparison to the high-level combining alternative that we considered. More significantly, the Jampro antenna gives us redundancy as a low-power backup for our analog and digital channels if our main transmitter goes down.

The JLST antenna mounted on the tower.

SATISFYING LISTENER RESPONSE

From the positive market response we have been receiving since last November – when we inaugurated our new HD-1 and HD-2 channels – we know that listenership has increased. Because of the diversified programming made possible by HD Radio, our listeners are more satisfied than ever before.

Our new HD-1 channel is simulcast with our analog signal as required, and we have a new HD-2 music-only venue that airs around-the-clock. The HD-2 programming is also fed to Internet listeners. (We currently are receiving more hits on our HD-2 programming Internet stream than on our analog programming Internet stream.)

We have begun to receive unsolicited donations from listeners due to the fact that they like our two new HD channels. It is not only unexpected and a pleasant surprise, but breeds fresh optimism around the station that our future fund raising drives will be successful.

And, because people like our new HD channels, they are asking where they can buy HD receivers. One listener was so impressed with our HD-2 programming that he inquired about getting an HD set for his barn – to play music to his show horses. Who knows, perhaps they will show better with inspirational music!

HD AND JAMPRO WORK WELL TOGETHER

HD Radio and the Jampro JLST antenna have been good for WFCJ in many respects. Clair Miller recently said, "Our initial listener response numbers indicate that they are listening to the main channel when they are driving to and from work. When they get to the office, they listen to the all-music HD-2 program."

There is no question; the HD audio quality is a great addition to our station. Our listeners like HD. They evidently want to support it with contributions and keep our mission of providing quality religious music and teaching moving forward.

I am glad we went digital earlier than we had planned. We are pleased we were able to get as good a signal – and yet save as much money – as we did with the Jampro antenna.

John Graham, CSRE, CBNT, has been Chief Engineer at WFCJ-FM for the past 24 years. Graham can be reached at john@wfcj.com

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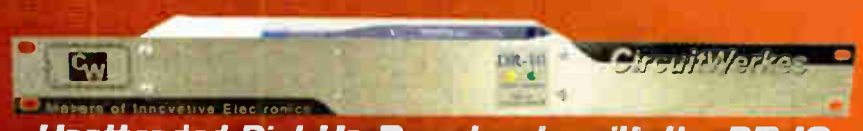

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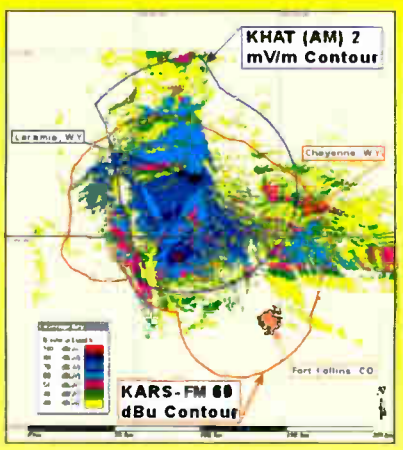

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Shively 6014 Dual Hybrid Antenna Solves a Dilemma

by Rich Parker

"The laws of physics are fairly predictable - but not so the laws of zoning," observed Rich Parker of Vermont Public Radio. The broadcaster was faced with a need to rectify a downward radiation issue. A solution satisfying tough technical and political demands was required.

Over ten years ago, new FCC Regulations for public exposure to radio frequency radiation (RFR) dictated a substantial decrease in levels was necessary for WVPS (109.7) at our Mt. Mansfield tower site. The existing six-bay Shively 6810 – side-mounted with a center of radiation (COR) only thirteen meters above ground level – was clearly not going to be able to be brought into compliance.

SEEKING A SOLUTION

The downward radiation from WVPS' 49 kW signal had to be lowered to 20% of its original value – from 1000 uW/cm2 down to 200 uW/cm2.

At this pristine mountaintop site there was no fencing allowed, so permission was granted to close the trails temporarily to restrict access to the area while a solution was sought. Then we called Shively's Bob Surette for advice.

One option was to move to a nearby 200-foot tower, where station WEZF (92.9) had been operating for many years into a Shively 6015 panel antenna. The easiest option seemed to be replacing that antenna with a broadband Shively 6014 panel antenna array and using a diplex combiner to feed both stations into the antenna. Shively started work and produced a new three-around, four level, 0.9 wavelength antenna.

In the meantime, heavy political forces were at work on the shared mountaintop site. HD TV was on the horizon and, because of the unique environmental and regulatory environment in Vermont, all the parties had to bond together in what was called the Mt. Mansfield Colocation Committee.

DEVELOPING A MASTER PLAN

The Master Plan was to coordinate the transition to HD TV, reduce RFR at the site to meet the new stricter guidelines, and work to combine as many radiators into as few towers as possible. Because of this, it was not possible to simply replace the 6014 panel antenna and move over to the new transmitter building. That would have been too easy. Thus, the antenna would sit at the factory for years, waiting.

During the ensuing years, the project morphed into one wherein the final plan involved the building of three new towers (each under 200 feet so lighting would not be required) and combining as many radiators as possible on each tower. (The older towers are to be removed after the transition to HD TV this winter). After extensive debate and discussion of more than a dozen options, combining the FM signals into a panel antenna was still the most viable.

As time went on, it became apparent that HD radio was close on the horizon. The original plan was to use analog/digital combiners with the Shively-developed Digital Injector. An existing Harris FM35K transmitter would supply the analog portion of the signal; the HD signal would be generated by a solid-state 6 kW digital transmitter, which would promptly dump something like 5+ kW into a dummy load as heat. However, some exciting new changes were happening in the world of HD transmission systems.

SHIVELY DEVELOPS REVERSE INJECTION

Shively had recently proven the concept of employing the previously unused hybrid port of their panel antenna for HD signal injection. This produced an HD signal at the antenna of opposite polarity from the analog signal. A station's analog signal could be applied to one port of the hybrid, and the digital signal to the other.

As built, the new broadband panel antenna exhibits an isolation of about 20 dB across the band between the ports. An isolator – essentially a circulator with a dummy load – was then placed at the output of the HD radio transmitter, to provide higher isolation between the additional RF coming back down the line from the higher-powered analog FM transmitter and the HD transmitter.

The Shively 6014 panel antenna.

In order to optimize system isolation, a Shively fine-matching transformer was placed between the circulator and its dummy load, improving the match. Overall system isolation was improved sufficiently to produce a voltage standing wave ratio (VSWR) of approximately 1:1.02 as seen at the digital transmitter – good by any standard. As a bonus, the Shively fine-matching transformer, used previously on the old system, had been repurposed.

REDUCING HD POWER REQUIREMENT

The remarkable thing about all this was that by using the dual input hybrid, it was possible to scale down the requirements for the HD transmitter from more than 6 kW transmitter power output (TPO) to less than 750 watts TPO.

Additionally, when WEZF moves off of the existing older tower and onto the new antenna, the dual-input system will allow this simply by adding combiners. The WVPS 107.9 analog signal will be combined with the WEZF 92.9 HD signal up one transmission line; the WVPS HD signal will be combined with the WEZF analog signal up the other transmission line. Each line will feed a separate input of the antenna hybrids.

A benefit of this arrangement was that we could specify a slightly larger than necessary HD transmitter and use it in FM+HD mode as a backup transmitter for each system. To go to low power backup, it is simply a matter of placing the Z2000 in HD+FM mode and turning off the FM35K main analog transmitter. We have found that when feeding the 6014 antenna in this way, the station's coverage is still quite remarkable for such a large reduction in power.

A PLAN FOR SURVIVAL

Due to the harsh nature of the weather at the site, Shively was asked to design and build a radome for each of the radiating elements of the panels – something they had never been requested to do before for this particular panel antenna. Additionally, because of visual and other environmental factors, they produced a new grey color formulation for the radomes on this installation.

Custom designed radomes.

The project was finished not a moment too soon. The final antenna installation happened fairly late in the year for Vermont mountaintop sites, and it was early October before everything was powered up. Within a couple of weeks the site was hit with a major snowstorm. The new antennas under the radomes performed perfectly even though they were covered with snow and rime ice.

Another protective measure was to place the power dividers of the feed lines below an ice guard inside the tower structure. As designed, the tower is a standard lattice tower with a shell of steel surrounding it. The surround is on special mounts to simulate the look of a large monopole.

The Shively 6014 performed well in this environment.

There is an access panel in the bottom with a standard ladder up through a circular ice guard at the base of the FM antenna bays. It was beneath this platform – but between the tower and the shrouds – that the coupling elements of the power dividers for each of the individual antenna element feed lines were located. Additional protection was thus provided.

EASY ACCESS

Due to the dozens of feed lines for the FM and HD TV antennas it was no longer possible to climb up the interior of the tower. In a bit of innovative design and fabrication, Shively was able to incorporate a reinforced climbing ladder into one face of the FM antenna's reflective backplanes. This allows tower workers to climb up to the TV antennas above by going onto the tower platform and then climbing the rest of the way on the rungs integrated into the FM panel antenna.

Mount Mansfield is an extremely harsh environment with many challenges. Now that this installation has been through its first winter, it is clear that the design provided by Shively was right on target. With another winter season approaching, a Shively engineer will be coming up one more time to sweep the antenna system.

The dual, equally-sized transmission lines allow the transmitters to be split between the two lines so swapping the lines will be easier if damage were to occur to either line. The system also was designed to maintain pressurization up through the feed points of each bay. Even if there were to be damage to an individual line, the entire system would still be protected.

Now with our antenna COR more than 150 feet above the surface of the mountain, there are no more problems with public exposure to RFR. Furthermore, the additional height has eliminated much of the low radiation-center "bounce" from the old antenna that had caused additional reflections and multi-path.

FUTURE PROOF

The new Shively 6014 is "future proof." As it is a broadband panel, it can accommodate expansion opportunities such as other tenants seeking to locate at the site.

The installation promises to be the crown jewel of Vermont Public Radio's statewide network. With WVPS 107.9 now broadcasting in HD multicast, the station is able to provide a multitude of services to its listeners.

Rich Parker is Director of Engineering at Vermont Public Radio. He can be contacted at rparker@vpr.net

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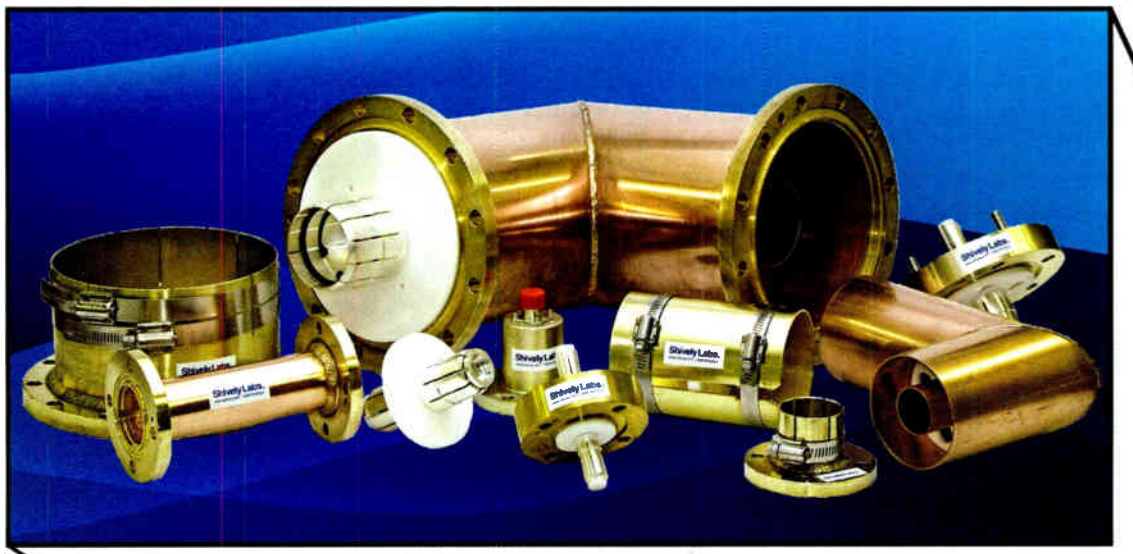

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Dielectric Saves the Day

by Brian E. Brachel

In October of 2006, WKHQ-FM, Charlevoix, Michigan, suffered a severe antenna burnout of its eight-bay antenna. The Class C1 100 kW station was reduced to broadcasting on a single bay, stand-by antenna.

WKHQ was in need of a good, high power antenna that could be delivered immediately.

DIELECTRIC DELIVERS

An engineering friend of the author, Del Reynolds of Northern Star Broadcasting, recommended Dielectric Communications. Del has several Dielectric antennas installed at his stations, including one at a full Class C which has been on the air for over 12 years with no problems. The owner of our corporation, Trish Garber, gave me permission to proceed with the purchase.

Matt Leland, National Sales Manager of Dielectric Communications, was made aware of our emergency. I told him about our burnout, and explained our requirements.

Although time was of the essence, the purchase of a new antenna gave us the chance to re-engineer the system a bit. As part of the process, I was looking to recover some of the cost of the antenna replacement by increasing the number of bays, thus reducing power consumption and increasing tube/transmitter life.

We were hoping to put as much energy as possible into a particular populated area some 40 miles to the southwest of the transmitter site. The station is in an area in which the population centers are pretty diverse, and we could afford not to use any null fill or beam tilt.

Matt suggested that we purchase the Dielectric DCR-M-10C, ten-bay antenna. He told me that Dielectric could have the antenna completed in a week and shipped. We placed the order and, true to his word, Matt made sure the antenna arrived by truck on the 10th day.

READY FOR INSTALL

Everything was foam-packed in six crates. The instruction book for assembly was clear and well laid out. There was plenty of hardware – and extra pieces were included, just in case.

We had our tower climbing engineer, Glen Walker of Walker Tower, remove the old antenna and prepare for the new one. What was remarkable about Glen's work was that he had the old eight-bay antenna down in one day – from a 590-foot tower. What was even more remarkable: Glen was 74 years old!

He liked the Dielectric DCR-M-10C because it was light and could be easily assembled on the tower. We were about to find out just how easy that antenna was to erect and tune – without the need for a sophisticated network analyzer.

THE DE-ICING CHOICE

My friend Del has had good fortune running his ten-bay antenna at 2050 feet above mean sea level (AMSL) without de-icers or radomes. As radomes would add wind loading to the tower, we decided to go the same way. Why put added stress on the tower if it is not needed?

We do get plenty of ice in Northern Michigan, but not as severe as some of the more transitional areas like Ohio or Indiana. Our icing is usually not thick enough to cause severe VSWR change on a broadband, center-fed antenna like the DCR-M-10C.

INSTALLATION

Glen's daughter Melissa and I were the ground crew. We would build a section and send it up to Glen. After the first day we had five bays in the air and the last five bays were up on the second day. Because of a slightly different center feed location, Glen had to do some readjustment of the 3-1/8 Andrew Heliax® on the tower. That was completed on the third day, and we were ready for some power.

The antenna had been optimized at the factory for our operating frequency. The antenna was purged with nitrogen for several cycles and finally pressurized to 5 psi. I liked the fact that Dielectric has pressure popoff valves to protect the antenna in case of over-pressure.

Up she goes! A bay of the Dielectric antenna is ready for installation.

POWERING UP

We calculated a transmitter power output (TPO) of 22 kW for the new array and began to excite the antenna. The power was slowly increased to about 18 kW, when I noticed the reflected power on the Bird system was approaching 200 Watts. This is higher than I like, but we ran out of time that day. I kept the power at 15 kW overnight.

I noticed, too, that the reflected power meter had some wiggle to it. Slight though it was, it resembled arcing. Glen's forty years as an engineer and tower climber said that we were seeing the FM carrier sidebands because the antenna was mistuned. Glen would come back on the fourth day of our installation and field tune the antenna.

Access to the tuning elements on the Dielectric antenna does not require any disassembly of the antenna. There is no requirement to observe impedance, reactance or admittance on an expensive network analyzer. However, I do not want to downplay or make light of good engineering practice. If you have access to a network analyzer, you can really zero the antenna for a VSWR that will work well in ice and non-ice conditions. Whether you have an analyzer or a VSWR bridge, the tuning procedure is the same.

Adjustable tuning elements make on-tower work a snap.

There are a series of four adjustable tuning elements in the tuning tube that you simply pull out or push in. While Glen was on the tower and in low power mode with a low power slug, we were able to get zero indicated reflected power within five minutes. After Glen was down from the tower, I went to full TPO of 22 kW. The reflected power did not come off the peg. It was still zero. Not bad for five minutes of tuning work.

ON THE AIR

As mentioned previously, we did not have a pressing need to null fill or beam tilt the antenna. However, I did notice a change at about fifteen miles from the site, at a location that is lower than the surrounding area. Because of the vertical beam width being narrower than with the old eight-bay antenna, the station seemed to have slightly less signal in that particular area.

I was able to tune the old CSI transmitter for a better AM noise figure and, combined with some changes to our processing, multipath was reduced. Coverage in that area became more acceptable to the owner. To fix the problem permanently, Matt told me of a minor modification which could be performed on the array providing a beam-tilt down one to two degrees. We have had no near-field issues requiring the use of null-fill components.

Another installation of the Dielectric DCR-M FM antenna.

The new antenna opened up our high frequency audio response. This change required me to reduce the HF component on the Omnia processor by about 4 dB. Our signal was checked on a spectrum analyzer to confirm that the carrier waveform and SCA's did not change on the new array. All the engineering was now good to go.

HANDLING THE WEATHER

On some occasions this past winter, I observed about 200 Watts reflected at 22 kW forward. However, over one two-day period we did have a very bad icing event. The VSWR was over 600 Watts at 22 kW.

My Bird meter is set to reduce TPO 3 dB – or to about 11 kW – if there is over 600 Watts of reflected power at 22 kW. The system quickly settled down. So, fortunately for us, the icing problem experienced this winter was nothing to be concerned about.

A BLOWTORCH BRINGS NEW LISTENERS

I can honestly report that this antenna is a blowtorch. The station continues to perform well in areas covered by the old eight-bay antenna. In addition, this antenna has given us new listeners in the city of Cadillac, some 70 miles to the south. We are also performing well in the Upper Peninsula as far as Sault Ste. Marie, and west to Newberry. We run an Inovonics 705 RDS unit with 3.5% injection. I can decode that RDS subcarrier both in Cadillac and in Newberry.

We were 100% back in the saddle on WKHQ just three weeks after the major outage. The owner and PD are very happy. When they are happy, I am happy.

From quick delivery, to ease of assembly, tuning and great performance, this engineer would rate the Dielectric DCR-M-10C antenna a 10 out of 10. Dielectric will be used without hesitation on the next upgrade of our other Class C1 station.

Brian E. Brachel (K8LQ) has been employed as Chief Engineer with MacDonald Garber Broadcasting for over 10 years. Brian can be contacted at brian.brachel@106khq.com

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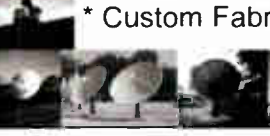

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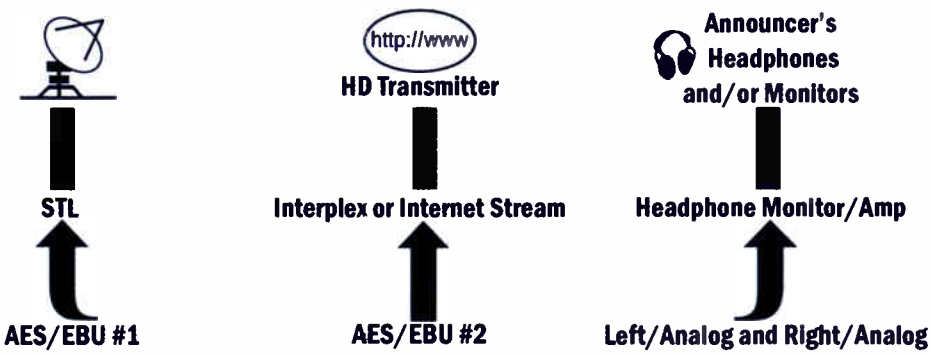

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