

# REBUILDING A LEGEND: REBUILDING WOR RADIO FROM THE TIP OF THE MIC TO THE TOP OF THE TOWER

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## ABSTRACT

WOR Radio is one of the oldest radio stations in the United States, signing on for the first time February 21, 1922, from the radio department of Bamberger's Department Store, Newark, New Jersey. The ensuing 80+ years saw the WOR studios move to Chickering Hall uptown, to 1440 Broadway in 1926 where WOR remained until 2005.

On the transmitter side, WOR went from 500 Watts to 5,000 Watts with a transmitter site move from the roof of Bamberger's to a site up the road from Bamberger's. In 1936, the Carteret, NJ facility was built, along with a power boost to 50,000 Watts and a directional antenna. President Franklin Delano Roosevelt threw the ceremonial switch to launch a high power Golden Age of radio for WOR.

In the early 1960's, it had become obvious that WOR's three tower, quarter wave directional antenna, about eighteen miles out of Manhattan, was just not able to cut through the noise of the rapidly growing metropolis called New York City, and the site was moved to a recently closed dump in Lyndhurst, New Jersey: the Jersey Meadowlands. This site featured towers almost a half-wave in height, arranged in a "dog-leg" arrangement to put the major lobe directly over Midtown Manhattan and the secondary lobe straight down through New Jersey towards Philadelphia. This site served WOR well until September 8, 2006, when the newest facility in Rutherford, New Jersey, was placed into operation.

This paper will take us through the process of relocating the studios and offices of WOR, as well as the transmitter facility in Jersey.

## THE NEED FOR OFFICE SPACE

In the spring of 2004, WOR was starting the renewal process of the lease of our space on the 23<sup>rd</sup> and part of the 22<sup>nd</sup> floor of 1440 Broadway. The building had been part of the Helmsley/Spears conglomerate, and had been sold. The new owners had made many upgrades to the building, including a completely renovated lobby and updated elevators. But the new owners thought they had built the Taz-Mahal. Their offer to WOR would have increased our rent immediately by a factor of 2.8 times, almost tripling our

rent. The new building owners would not bend from their demands, unless WOR agreed to move to a lower floor in the building. We were told that we could have the basement for the amount we were spending for rent at that time. Psychologically, it did not sit well with Buckley Broadcasting President Richard Buckley: taking a legendary radio station and relegating it to the basement of the building. Secondly, the N/R/W subway lines run under Broadway as close as 50 feet under the building foundation. There was simply no way from a noise standpoint that radio studios could be located in the basement of the building. They would be prohibitively expensive to noise-proof.

## THE SEARCH BEGINS

In a City like New York, one simply does not go out on their own and rent office space. You need a real estate broker, and Rick Buckley knew a very good one, Miles Mermel from Tenant-Wise. First, we needed to establish our criteria:

- The rent range we were willing to accept.
- We needed 23,000 square feet of space on one floor, rather than having space on two floors.
- We needed adequate power for the studio area.
- We would need roof rights to install antennas for reception and STL.
- We would need to either tie in to the building's emergency generator, if it had one, or would need the right to install one on our own.
- We would need our own air conditioning system for the studio area.
- The building would need to have the proper telephone facilities, in particular, fiber, to make it work.
- The building would need to be easily accessible.
- We would need 24/7 access.

Miles located several buildings. Rick Buckley, VP/General Manager Bob Bruno, VP/CFO Joe Bilotta and I went on hours of tours. Numerous buildings were immediately vetoed for various reasons. Reasons like, they would not allow the installation of a generator, or having to go through metal detectors and x-ray machines to get in. Can you imagine someone like Lewis Black having to go through that for an interview? He'd have new material for his show.

We finally settled on three buildings. The overall deciding factors on 111 Broadway were:

- The building was willing to work with us to make our move happen – whatever it takes.
- The building is located two blocks north of Wall Street in a very good and accessible area of New York.
- The rent agreement was very good.
- The building is a restored turn-of-the-century building that is absolutely beautiful, with gold trimmed ceiling ornamentation in the lobby and stained glass windows in most of our offices. It truly has the class that is WOR.



The entry hallway into WOR's new home, 111 Broadway, New York City.

An agreement was reached, and planning began.

### PLANNING THE BUILDOUT

Things began to move rapidly in the fall of 2004. We decided to keep a good portion of the offices and the lobby as they were on the south side of the floor. The west end, where producers and talent were to be located; the east end where sales was to be located; and the north side, where the studios and Master Control Room would be located, would pretty much need to be gutted.

Architectural drawings were made, studios were laid out, with the following caveat: the studios at 1440 Broadway were huge, having been built in another era.

The typical studio at 1440 was 20 feet by 30 feet. The typical control room was 20 feet by 15 feet. The new control rooms are 15 feet by 8 feet, and studios are 15 feet by 17 feet.

We decided to put the technical area, studios and Master, on a 6" raised computer floor. This would facilitate wire runs and keep them out of the ceiling, which would be packed with air conditioning ducts, as the building systems are shut down from 6PM to 6AM and on weekends. We needed to provide our own air conditioning for the studios and Master.

That presented another problem. The building at 111 Broadway is a Landmark building, being one of the original high rise buildings in Manhattan. There are strict conditions in regards to what you can and cannot do to Landmark buildings. The floor we would be on, floor number three, has louvers in place for the building air handlers and, luckily, louver space which could be used for the studio air conditioning. This space is limited, and the air conditioning units barely fit in the space allotted.



WOR's new home: 111 Broadway, New York City.

### SPECIFYING SOUNDPROOFING

For construction of the studios, we literally took a book out of the Lucasfilms THX manual, and designed the studios to their specifications. They are constructed of two layers of 5/8 inch sheetrock attached to the studs, fiberglass insulation blankets, another set of studs (not connected to the first set of studs), two more layers of 5/8 inch sheetrock, and Armstrong SoundSoak. The

sheetrock goes deck to deck and is sealed to the decks with sound rated caulk. The ceilings are two inch thick fiberglass tile. The space above the ceiling is lined with “duct liner”, a thick fabric that is normally used for lining air conditioning ducts to reduce noise transmission. The entire space is lined. The air conditioning returns cascade through the studio ceilings. There is a duct in the shape of an “S” between each room, the “S” points down in one room, and points up toward the lining material in the next. All air conditioning ducts are lined. This has effectively kept noise transmission between rooms to almost zero.

## WINDOWS

One advantage the studios at 111 Broadway have over the studios at 1440 Broadway is that they have windows. Granted, they look out onto Thames Street, a very narrow street that runs between 111 Broadway and its sister building at 115 Broadway, but there are windows none the less.

The building replaced every window on the floor when we started construction. And I distinctly remember the conversation about having to sound proof the windows I had with Rick Buckley. I was not pleased with the street noise I was hearing come through the windows. He responded by saying that “this is New York. People are used to hearing noise in New York. It’s not that bad”. As luck would have it, the high school on Church Street let out as we were having this conversation. It quickly became obvious that I was right, as we could clearly hear every “F” word that was shouted. That would have played really well with the FCC’s crackdown on obscene words.



The inside window in front of the outside window. This piece of plate glass reduced noise from outside by greater than 60dB.

We decided to leave about an inch or so of air space to the building’s windows, and placed a ½ inch thick piece of plate glass over the window in a frame. This effectively took the outside noise down a good 70dB. And it was fortuitous we did this: we were building in

winter. When summer comes, the restaurant downstairs in our building hires local rock bands to play on Thames Street. That would have made the studios completely unuseable.



This area would become the new WOR Master Control Room.

## CATCHING AN “OOPS”

We decided to go with Studio Technologies furniture. First, the quality is very good. Second, being in the Philly area, they are local and could do the installation.

Vince Fiola came in one fine afternoon to do a final measurement on the rooms to make absolutely sure our furniture would fit. This was before the computer floor was in, and the mock up of the studio windows was in place. There was only one problem. It looked too high in the wall between the control room and studio. Vince measured it. It was a foot too high when the computer floor was taken into account.

Just then, our architect came around the corner. So we told him the window needed to come down a foot. He said he put it at that height so “if anyone puts stuff on the counter, it won’t be seen in the other room”. So I asked him what I was going to do about our five foot tall producer that wouldn’t be able to see above the bottom window frame and therefore couldn’t communicate with the host visually. Even though he had sat in on our studio operations at 1440, it didn’t strike him that the personnel in the control room and the talent in the studio needed to and relied on seeing each other. I’m glad we caught this while it was only roughed in.

## PLANNING TO MOVE A MONSTER

WOR wanted out of 1440 Broadway as soon as possible. But because of construction schedules and the fact that Engineering is responsible for not only the studio area but all phone systems and computer systems, and because moving 100 people in and of itself would be a major undertaking, we didn’t want to

attempt to get the studios online at the same time as the office move. It was decided to move the offices first.

We met with Verizon, the local phone company, and our reps from AT&T. The PBX is fed from 4-T1 circuits through AT&T. We needed two T1 circuits to ABC Radio Networks at 125 West End Avenue uptown for audio transmission for uplink of The WOR Radio Networks. We needed two T1 circuits, taking completely different paths out of the City, to the transmitter site(s), one in Lyndhurst, New Jersey, and the one being constructed in Rutherford, New Jersey. We needed 3 other T1 circuits for the various POTS lines from AT&T. We needed about 18 POTS lines from Verizon. And we needed 30 ISDN circuits, as we use Telos 2X12 phone systems and feed them with ISDN. Verizon got busy installing fiber and a mux on the third floor.

Decisions were also being made as to what furniture would travel from 1440 to the new location, and what would be purchased new. Offices were being laid out. Mine was to be in the same suite with the General Manager, as opposed to being in the studio area, which I thought was odd. Later, after the move of the studios and offices was complete, Rick Buckley named me a Vice President, so there was a method to his placement of my office all along.

### **WHAT ABOUT THE TECHNICAL SIDE?**

While all the above was going on, it was time to figure out how to outfit the studios. I personally went to visit Wheatstone, Harris/Pacific, talked with SAS, and had in depth conversations with Kirk Harnack, Frank Foti, Mike Dosch and Steve Church of Telos/Axia/Omnia.

I decided to take a chance on being the first large scale integration of the Axia System. There were several things I liked about the Axia system, among them having no single point of failure, being able to basically design the amount of redundancy I wanted into the layout, and having to only run one cable to each studio. This would be a major plus, as we were short on time and didn't need cumbersome multipair to run and punch down. Plus, the Axia system interfaced directly with the Radio Systems Studio Hub system, greatly simplifying and speeding up installation as readily available off-the-shelf Cat-6 patch cords could be used to connect studio equipment along with Radio Systems XLR-to-RJ45 dongles.

We also would be in need of a systems integrator, because of all the work that needed to be done with the office side, plus laying out of the studio side, plus having to constantly check on what was happening at the transmitter site, and on top of our busy remote schedule. I chose Andrew Rosenberg from Creative Studio Solutions of Wheat Ridge, Colorado to perform

the integration. I had worked with Andrew previously and knew that we could work well together, as I had specific ways I wanted certain things done.

Right after Christmas, 2004, while the studios were still being put together construction wise, we started integration.

### **BACK TO THE OFFICE**

Because the studios would be remaining at 1440 Broadway to start, certain personnel would be left up there, among them the Program Director, all the Producers and Talent, the Operations Director, the News Director and Newsroom, and the Technical Shop. Since the PBX would be coming over to 111 Broadway with the offices, we needed a plan so people would still have telephones. The studio call in lines would not be a problem, as they were separate from the PBX.

We ordered in 35 Centrex lines from Verizon with voice mail attached. When the PBX moved, we would cut over these lines to the remaining phones, then "sling-shot" the normal phone numbers for the persons left at 1440 through the PBX. In this way, there would be no number change for anyone dialing those left behind.



The Mitel PBX in its new home, the utility room near the Producer/Talent end of the floor.

All phones and computer network connections in the office areas were pre-wired before anyone moved, including several Wi-Fi access points. We mapped out the PBX and made sure that the wiring to the punchblocks matched up with the correct extension numbers.

Meanwhile, construction on the office area was about to be complete, and we were ready to move the offices. On Friday, February 25, 2005, everyone except those to be left behind were told to fill boxes provided, General Services wrapped and packed computers and telephones, and at 5PM, the PBX was disconnected.



The elevator lobby on the 3<sup>rd</sup> floor of 111 Broadway, the entrance to WOR.

The trucks were being filled all day. It still took two hours from the time the PBX was disconnected until it rolled out of the freight elevator at 111 Broadway (keep in mind the new location is only 3.6 miles from the old location). The PBX was connected, the T1's lit up, and a call to AT&T showed that all was well. I went to my office and made a phone call. Then went to a hotel for the night.

The following day was spent plugging in phones, correcting any errant wiring, and getting computers up and running, while the staff, who had been instructed that it would be in their best interests to come in on Saturday and unpack, were setting themselves up. First day of business at 111 Broadway was February 28, 2005.



WOR's VP/Corporate Director of Engineering Tom Ray in a soon-to-be-completed studio 4.

## AS THE STUDIOS PROGRESS

Meanwhile, Creative Studio Solutions was making progress on cable runs and putting things together in the studios. I tackled Master Control, and started

populating racks. Axia was on site briefly to get us going with the system, but we were far from ready to program things and make them work.

It was also determined early on that we would not be able to see the transmitter site from our new location. We rented space on 4 Times Square for an STL repeater, and would be shooting through a narrow window up to Mid-town, then over to Jersey. The Gods of RF were smiling on me. I found what could be the last available STL frequency in the City, and that would be our link to 4 Times Square.



The view to the 4 Times Square building from the roof of 111 Broadway for WOR's STL shot. The building is in the center of the photo.

The T1's to the transmitter sites were installed. We brought the backup Intraplex unit over to 111 Broadway and were soon "talking" to Jersey. All of our satellite equipment is at the transmitter, so "Y" adaptors were added to feed both Intraplex units. We now had external audio coming into the studios! Now we could play and start programming the Axia system.

I should mention at this point that the "Y" adaptors were added around 3AM one fine morning near the end of March. As luck would have it, the power company in Jersey whacked us good. At 11PM one night, the Harris DX-50 main transmitter failed. We found 3 shorted rectifiers, then needed to run the transmitter through its paces before buttoning it up. So, since the opportunity to be at the transmitter had arisen (along with myself and another Engineer), we cut the satellite channels over.

## STILL MUCH TO DO

They say the devil is in the details, and that is exactly what needed attention. Arrangements were being made to put the STL antennas on the roof of 111 Broadway and 4 Times Square, and get the link from 111 Broadway aimed. We wouldn't be able to aim the link from 4 Times Square to Jersey until last minute. All

this was done by the first week of April, and the link to Jersey was aligned the Friday morning of the studio move at the end of April.



The STL antenna, AM receive loop, and DirectTV dish on the roof of 111 Broadway. Note that the Mark grid dish is painted the same color as the penthouse. The AM loop antenna should be pointing at the camera, but offers no signal in that direction.

One problem we had were the T-1 circuits to ABC Satellite Services. The first one was installed and we then tested and set levels with ABC the day before we were to move. The second T-1 came up two weeks after the move. We unfortunately had to run without hot backup for two weeks.

We were using Axia Pathfinder as a studio switcher, and right after NAB, John Makely, Mike Dosch and crew arrived for the final touches. We spent countless late hours designing paths, testing studios, testing switching, deciding what sources each studio needed access to and creating those sources in the system. At one point, someone moved my laptop out of their way and Rick Buckley quipped, "Careful! He's got the whole damn radio station in that thing!"

We found that there was an audible "pop" when changing studios. Axia needed to find the source of the software glitch causing the problem and off we went. Audio chain levels were being aligned. Studio telephone numbers were being tested. There was too much happening at once.

WOR also has unique uses for Pathfinder. WOR is a talk station, and we don't believe in dumping delay unless someone says something really bad. We'll bleep out the word or the offending call letters of our competition. At 1440 Broadway, we had an analog switcher in the delay line in each studio. If something needed to be bleeped, the operator would switch to listen to the outgoing audio, press the bleep button which would put an oscillator on the air, and release the

bleep button when it was safe to do so, putting program audio back on line.

Having everything in the digital domain would not allow for analog switching. The Axia crew designed a method for Pathfinder to intercept the button press for a bleep, determine if this studio were on the air or feeding one of the Radio Networks, and route a bleep tone to the appropriate output buss. When the operator releases the button, Pathfinder remembers which studio was on what buss and puts the studio audio back online.



The computer screen for Axia's Pathfinder, WOR's studio switcher and all around system information shuttling device.

We also use Pathfinder to create various intercom paths that are normally not standard in any console system, such as giving the producer direct access to a talent's headphones. All of this is possible through the GPIO nodes in each room.

We have Pathfinder route the cues for The WOR Radio Networks from the studio or Network refeed ENCO to the cueing encoders which feed to ABC and then to the local station's Starguide receiver. This was a big change from 1440 Broadway, where we generated subaudible tones in each studio which were decoded in Master, then pulsed the cueing encoders to ABC. Because we operate a live show in profanity delay, the cue buttons in each room are routed through the Air Tools delay units, which will delay contact closures by the delay amount.

This solved another problem we had at 1440 – we couldn't go to break on either Network if we had dumped delay and were ramping back in. The delay units would pitch shift the subaudible tones just enough that they would not decode in Master. By being able to send straight contact closures, and have them delayed correctly, life has been made much easier.



The WOR Master Control Room at 111 Broadway.

WOR uses an ENCO Digital Audio Delivery System, which was not replaced for the move. The majority of the studio equipment at 111 Broadway was brand new. The ENCO system would not be. On the Thursday before the move, we brought the backup server to 111 Broadway. Operators were busily making backup CD's of the entire log for Friday night, Saturday, Sunday and Monday, just in case. We also planned on operating with entirely recorded programming after the Morning Show on Saturday, and again on Sunday, so we wouldn't have Talent tripping over us and vice versa. Only the newscasts would be live. On Friday morning of the move, after the Morning Show signed off the air, we disabled several studios at 1440 and brought the ENCO workstations which were freed up to 111 Broadway.



Control Room 4 during Henican and White, an intimate setting. Producer Naomi Gabay, foreground, Engineer in Training Jerry Bell, and Engineer John Feret at the digital editor.

After the ENCO workstations were connected and levels verified, we had the operators come in and touch the consoles – the first time they had been able to do that when at least three studios were fully equipped. Talent came in and got used to the sight lines and the sound of the new facility. What could be packed up at

1440 was in the studio area: the Producer's desks and other areas were not a problem to pack.



Lynne White and Ellis Henican of Henican and White in WOR's Studio 4.

On Saturday, April 30, 2005, I called ABC Satellite Services at 10AM, and they cut WOR Radio Network one over to 111 Broadway. The first program aired on the WOR Radio Network one at 10:06:40. At 11AM, I called ABC again, and we cut over Network two. At 11:06:40, both WOR Radio Networks were operating out of 111 Broadway. I called Master at 1440 for the last time at noon. Near the end of the live newscast, I told the operator to position the mouse over the correct button on the transmitter remote control screen, as with the HD delay, I wouldn't know when to hit the button to switch locations.

Bob Gibson had the final words from 1440, announcing that he was doing the final newscast from those studios, ending with, "and you're listening to WOR, New York". The operator hit the button on the remote control, the audio switcher at the transmitter site switched to the Intraplex from 111 Broadway, and the new facility was completely on the air at 12:06:40. We missed zero airtime.

### **BUT WAIT – THERE'S MORE!**

Eloise Maroney, our Operations Director, got lunch for those of us slaving away. Meantime, the Engineers at 1440 were gingerly removing the main server and remaining workstations of the ENCO system, then gutting the audio racks. Some equipment would be reused. Some would be sent to other Buckley stations. Some would be sold. Some would go into dumpsters.

The ENCO and other equipment finally arrived at 111 Broadway by 7PM. We had ENCO up and running fully by 10PM, everyone retired to the hotel before we all passed out, only to be back at 9AM Sunday to tie up loose ends, correct problems, reposition things.

I needed to go to the transmitter Sunday morning and cut over the microwave units and remaining Intraplex to 111 Broadway, and our STL redundancy was back. There were still some minor issues when The WOR Morning Show hit the air at 5AM on Monday, May 2, but overall, the entire move was rather smooth, and more importantly, was transparent to the WOR listener.

## AND THEN THERE WAS SADNESS

I visited the 1440 location near the end of the first week of May to make sure everything that needed to be saved was out of the racks. I also had to make sure everything that needed to be saved was out of my old office, which I hadn't seen since January. It was sad looking at the old, original, 25 year old Pacific Recorders consoles that would be sent to the dumpster.

It was amazing to see the bundles of wire in the racks – God knows how any equipment ever fit in there. There had been a tremendous amount of history for WOR at 1440 Broadway, but the new studios have worked out very well.

## INSTALLING THE GENERATOR

I wanted to install a 50 kiloWatt generator on the roof of the building. But there was a problem. There is a subway line that runs behind the building under Church Street. There is a subway line that runs under Broadway at the front of the building. The Trinity Church graveyard is on the south side, and Thames Street is too narrow for a crane. Because of the subway lines, a crane is not allowed on Church Street or Broadway.

Any generator would need to be disassembled and brought up the freight elevator. And a 50kiloWatt unit wouldn't fit. A 35 kiloWatt unit would.

So we installed a 35 kiloWatt unit with a 125 gallon diesel tank underneath. There are no natural gas pipes going to the roof of the building, and the City will only allow 125 gallons of diesel. Propane is a no-no.

It was quite the sight seeing this genny dismantled, being crammed into the elevator, being removed on the 21<sup>st</sup> floor, then being hoisted with a block and tackle one flight to the roof. And then being moved over and around air conditioning units to its final resting place.

Of course, the generator has a story all its own. I mentioned previously that this is a Landmark building. You cannot modify the building outside in any way. Period. As it is, our STL antenna is painted the same color as the equipment penthouse. We had to perform physical measurements, put up a plywood mock-up of the generator, and photograph the building twenty-five

ways to Sunday to get approval from the Landmarks Commission to put the genny on the roof.



The generator sits in the south-west corner of the roof, hidden from street view by the facade. Ironically, the generator is almost the same color as the penthouse.

Incidentally, we have used it twice, as the building had to replace two 5,000 Amp switches for the electric utility in the basement – switches that had been in service since 1919! We discovered that 125 gallons will last in excess of 45 hours under full load. To refuel, we need to bring the diesel up the freight elevator in 5 gallon cans. We can bring it as far as the 21<sup>st</sup> floor, then need to carry it up one flight to the roof.

## SOME QUIRKS

I mentioned the windows in the studios previously. We found a few quirks along the way, the funniest of which was the newsroom.

Originally, we were considering doing newscasts in the center of the newsroom. Unfortunately, the newsroom windows are right over where the rock bands play, and fairly close to Broadway. So rather than build an edit booth in News, we chose to use it as the air studio.

What no one caught was that on the other side of the wall in this booth is a bathroom, located in sales. You can imagine the look on everyone's face in Master Control the first time someone in the bathroom flushed the 'ol commode and we heard it on the air! Needless to say, there is now a modified on-the-air light in the bathroom that says "DON'T FLUSH" when the newscaster's mic is on.

Another quirk is that, with the AM loop antenna on the roof pointed in the direction of the transmitter site, we have absolutely no signal. The antenna is 45 degrees off axis where the signal peaks. All I can figure is that it is some phenomenon with the way the signal propagates around the buildings.

Yet another quirk was discovered when the building air conditioning ramped up in May. Our off-air signal became unlistenable. Yet on the roof, the signal coming off the loop was clean. I built a small AM amplifier, phantom powered through the coax from the Master Control racks, and mounted it in the penthouse before the cable left the building to the loop antenna. This raised the signal available in Master from 10mV to almost 100mV and eliminated the interference.

## THE SUMMER OF NO AIR CONDITIONING

Summer of 2005 arrived with a very hot spell – and it got very hot in the studios and Master Control room. Something was obviously wrong. And what was wrong was that the Air Conditioning Engineering firm screwed up.

When we were planning, I repeatedly told them I wanted 20 Tons of air conditioning for the studios and Master. They repeatedly asked for heat load on all pieces of equipment – impossible for something like a CD player or computer. The manufacturers just don't provide that information. So, I added up the total power consumption of everything in the room and presented them with a number in kiloWatts for just the equipment, as a piece of equipment can't generate any more heat than the number of Watts it is consuming. This did not include a calculation for people or the sizes of the rooms.

The Air Conditioning Engineers had only put 10 Tons of air conditioning in. And told Rick Buckley, when I was out of town, that I told them that each room would be occupied by one person and a laptop computer. Luckily, Rick knows me better than that, and it then became the problem of the Engineering firm to correct the problem. They, however, had no clue.

So I did the calculations, and determined that the 10 tons that were installed were perfect – for the studios only. Add Master Control and the newsroom to the equation, and we were 15 tons short. Since we had no louver space on the building to play with, it was decided to tap into the building's cooling water supply and use a water cooled air conditioner to feed the Master Control Room and News. The existing units were rerouted to feed only the studios. The new unit feeds Master and News. All is well.

We also found that we needed to install filters between the outside air and the air conditioning units. The air in Manhattan is so dirty that the condenser coils were becoming clogged and severely reducing efficiency once per month.

## EQUIPMENT COMPLIMENT

Each “studio suite” at WOR includes a talent studio with an Axia SmartSurface, and a control room with an Axia SmartSurface. Some talent at WOR are capable of running their own consoles to a point. For most shows, however, the operator runs the board in the control room.

Each talent studio contains:

- 1-Axia SmartSurface console
- 1-Axia microphone node
- 1-Axia audio node
- 1-Axia GPIO node
- 1-Axia Engine
- 1-HHB Burn-It CD Recorder
- 2-Denon CD players
- 4-Electrovoice RE-27 microphones with shock mounts on OC White mic arms
- Radio Systems headphone amplifiers
- JBL 4408 speakers
- 1-Crown D-75 amplifier
- 2-Titus Technological Labs on-air lights
- 2-ESE Analog clocks (one is offset 8 seconds)
- 2-ESE digital clocks
- 1-Fostex speaker on the cue circuit
- Numerous computers
- Furniture by Studio Technologies
- 2-Samsung LCD televisions
- 1-DirecTV receiver

Each Control Room contains:

- 1-Axia SmartSurface console
- 2-Axia audio nodes
- 1-Axia GPIO node
- 1-Axia Engine
- 2-Teledyne 100MB Network Switches
- 3-HHB Burn-It CD burners
- 1-Air Tools digital audio delay
- 1-Telos Zephyr
- 1-Denon cassette recorder
- 2-Electrovoice RE-20 microphones with shock mounts on OC White mic arms
- JBL 4408 speakers
- 1-Crown D-75 amplifier
- 1-Fostex speaker for cueing
- 1-custom studio switcher panel
- 1-custom EAS control panel
- 1-computer running Adobe Audition, utilizing a Delta audio card
- Various computers and monitors for call screening, ENCO, and Internet browsers.
- 1-Samsung LCD television
- 1-DirecTV receiver
- 1-Telos 2X12 telephone system fed with ISDN lines and utilizing two Call Directors and two in-console control units.



Engineer Bob Iorio at the Axia SmartSurface in Control Room three.

The Axia core in the Master Control Room contains numerous Axia Audio nodes, a couple of GPIO nodes, two Teledyne 100MB switches, and two Cisco 1 GB Network switches, linked.

We are using Moseley Starlink 9003 microwave transmitters through a Moseley transfer panel as on-air STL, Moseley T1 units for transport of Network audio to ABC Satellite Services, and are using Intraplex units to transport audio to and satellite audio from the WOR Transmitter site plus data and telco.

Pre-processing for WOR, the networks, and the WOR Internet stream are Apex Compellers. We use an Air Tools Orion to process headphone audio for the Morning Show and to process pre-delay audio for the newsroom.

Master also has a Telos Zephyr Extreme, two Comrex G.722 codecs, and a CCS Micro 56 codec.

Master has their own console, an AudioArts R-60/12, along with numerous monitors and computers, and is home to the entire ENCO system.

### **IT BASED SYSTEM OBSERVATIONS**

The overall experience using an IP based system has been very positive. The flexibility is wonderful. This became obvious when The Dr. Joy Browne Show started simulcasting with Discovery Health television. The TV crew wanted all the mics, the telephone mix, and certain other items in the studio broken out. Seven items in all. I simply handed them an Axia audio node, programmed seven outputs and made them very happy. Total time? About ten minutes. And no multipair was involved, nor did we have to physically tap into the devices they wanted audio breakouts from.

It is also very easy to reconfigure the system in any way with a standard web browser. We can check system parameters on the audio engines this way, add or subtract what the operators can see for sources, change monitoring assignments. And each operator can set up his console the way he likes it for his particular show, then simply load his or her own profile when they set up a studio. It has proven to be a good choice.

From concept to on air, we built an entire facility in six months. The facility is working out very well and gives WOR the flexibility for whatever may come down the road.

### **REBUILDING THE WOR TRANSMITTER FACILITY**

WOR's first transmitter facility was on the rooftop of Bamberger's Department Store in Newark, New Jersey in 1922. This site utilized a Western Electric five hundred Watt transmitter feeding an open wire horizontal antenna. Around 1924, WOR's power was increased to five thousand Watts, and the site moved up the street from Bamberger's, still utilizing an open wire horizontal antenna.



WOR's first antenna on the roof of Bamberger's Department Store in Newark, New Jersey.

In 1936, WOR moved to a state of the art facility in Carteret, New Jersey, increasing power to fifty thousand Watts and utilizing a three tower in-line directional antenna, one of the first in the United States. This produced a figure eight pattern with one lobe towards Manhattan and the other towards Philadelphia. The site also featured a Western Electric transmitter.

In the late 1950's, New York City was growing, and the additional tall buildings and electric gadgets started causing trouble for the WOR signal in Manhattan. The Carteret site was 18 or so miles from Manhattan, but the site utilized quarter wave towers. Around the beginning of the 1960's, a rather large dump was closed in an area of New Jersey known as the Meadowlands. This area was only 6 miles from Manhattan, and a site in Lyndhurst, New Jersey was chosen.



The Western Electric 50KW transmitter at the Carteret, New Jersey transmitter site. The Engineer in the photo is unidentified.

The Lyndhurst site utilized a “dog-leg” three tower directional antenna and half wave towers. The dog-leg design allowed a large lobe of power directed over Manhattan and Long Island, and a smaller but respectable lobe directly towards Philadelphia. This site gave WOR the most concentration of RF over Manhattan of any New York radio station. It also featured detuning networks and traps in the tower tuning houses because of other AM transmitters nearby. This site served WOR from 1967 until September of 2006.

## REDEVELOPMENT

In 2001, the State of New Jersey decided to redevelop the part of the Meadowlands where the WOR Lyndhurst transmitter was located. An initial public hearing was held where concerned parties could voice their opinion. I represented the station, and our message was basically that we supported the efforts to redevelop the Meadowlands, but please leave WOR alone. It was obvious during this session that things had already been decided and the State was simply going through the legal motions – I had to interrupt myself several times to remind members of the board, who were clearly not paying attention and talking amongst themselves, that I was there to present our opinion and that it was their job to listen.

To make a long story short, the State decided to redevelop the area which included WOR's property, and WOR entered into an agreement with the developer, EnCap Golf Holdings, to rebuild the WOR facility. Let the games begin!

## CHOOSING A LOCATION

WOR needed about forty acres of land to accommodate our three tower dog-leg array. The good news is that the Jersey Meadowlands area is very wet – great for an AM ground system. The bad news is that this area is congested and there is potential for re-radiation everywhere, so finding property was going to be a challenge.

I traveled around with the representatives from EnCap for two weeks. I was presented with land that strictly wasn't big enough (I was actually told, “well, just run your ground radials around that building next door – I'm sure they won't mind!”). I was shown land that simply wouldn't work because of all the potential re-radiation sources nearby (I counted 10 steel electrical towers on one of the pieces of property!). EnCap sighed and then pointed me to a section of land just north of our Lyndhurst site that was virgin swamp that they had intended to remain completely natural as a buffer. I was able to carve out a 40 acre site to make the system work, and we were off and running.

There was only one problem. EnCap wanted us to start work RIGHT NOW, in 2002. We had not yet filed with the FCC. We were building in a protected wetland and did not yet have the Army Corps permits. There were many questions that needed to be answered.

Carl T. Jones Corporation was chosen to design and commission the new antenna system for WOR. The system was designed, and paperwork submitted to the FCC. To the FCC's credit, we received a conditional approval on the application within 9 months, pending FAA action. That is when the trouble started.

## FIGHTING THE FAA

The WOR Lyndhurst antenna system was designed to be overly efficient due to the traps and detuning networks that were required. There are three other AM facilities within 1-1/2 miles of the WOR antenna, 620 kHz, 1190 kHz, and 1010 kHz. In the 1960's, when the antenna was designed, there were no methods for computer modeling and it was very difficult to tell how the detunes and traps would affect the efficiency of the system. So the system was designed with 177 degree towers, 681 feet tall. It was found that the detunes and traps really did not affect the efficiency, and the system was grandfathered as overly efficient.

The new facility would need to meet the RMS requirements of the pattern, and was designed with slightly shorter towers, 171 degrees, 658 feet tall. The new location was ½ mile north of the existing WOR Lyndhurst facility, and therefore was ½ mile closer to Teterboro Regional Airport in Teterboro, New Jersey. Interestingly, even though most traffic into Newark Liberty International Airport in Newark, New Jersey goes straight over the WOR facility (and most planes begin dropping their landing gear at that point), Newark was not an issue.

The FAA initially came back and told us we needed to shorten our tower height by 30 feet. This would have put the efficiency of the antenna system below that required for a Class A AM facility, meaning that WOR would lose its Class A status. This clearly was not acceptable. We decided to fight the FAA. Carl T. Jones Corp. hired an airspace consultant.

What the consultant found was interesting. The Rate of Climb for a missed approach at Teterboro was set at 300 feet per nautical mile, meaning that a plane which needs to abort its landing for any reason must be able to climb out of the airport clear of any obstruction at 300 vertical feet per nautical mile. Just about every other airport in the country has a Rate of Climb set at 400 feet per nautical mile. Increasing this Rate of Climb would make the proposed WOR tower heights fine. There was no justification found as to why the Teterboro Rate of Climb was at 300 feet.

During this process, our consultant suddenly was not able to reach the agent we were assigned at the FAA regional office. After roughly a month, he was finally able to reach this agent's supervisor, and found that the agent had undergone emergency kidney surgery and would be out for another two months. Our consultant explained the urgency of our request, and asked that the case be assigned to another agent. Being bureaucracy at its best, the FAA supervisor stated that this would not be a problem – but the case would need to be restarted from the beginning. We decided to wait for the agent to return from sick leave.

Upon the agent's return from sick leave, it was agreed that there was no reason the Teterboro Rate of Climb could not be set to 400 feet per nautical mile. A circular was issued to the pilots who frequent Teterboro for comment. There were no negative comments, and the Rate of Climb was changed 30 days later. The FCC issued WOR's Construction Permit within two weeks of the FAA's approval, in March, 2003.

## **STARTING CONSTRUCTION**

While waiting for the FCC and FAA, we were able to perform certain tasks before all the paperwork was completed. Since the area we were building in was a

swamp, we were allowed to drill test borings to find out where bedrock was, as we would want the tower bases, guy anchor points, and transmitter building to be sitting on something solid. Our tests showed that the ground was literal muck until bedrock was found at 150 feet deep.



Cutting the Phragmites was the first order of business before conducting a survey of the location for the new WOR transmitter site.

We also were able to get all of our drawings made and approved, and obtain building permits. In another bureaucratic mess, the area is controlled by two entities: the New Jersey Meadowlands Commission and the Borough of Rutherford. NJMC issues certain permits, Rutherford others. Of course, their game is that they tell you what is required, you make drawings and produce seventeen (!) copies, submit them, and find out they “forgot” to tell you something that was required. They “forgot” 15 times. Oh. And I also needed to get a “soil conservation” permit. I guess the fact that we needed to fill, rather than remove soil, was overlooked.

Having paperwork in hand, we were ready to start construction. The contractor mobilized and was on site. And was then told to stop. Because the funding mechanism from EnCap was not in place, and no funding was available at this time. This was May, 2003. We would not be able to start until April, 2004. In the mean time, however, we were using a small contracting firm who had not taken on other work because of the extent of the WOR build. They now needed to be paid, as it was too late to bid on contracts for summer work. Needless to say, the time between May, 2003 and April, 2004 was a mess.

## **REALLY STARTING CONSTRUCTION**

When May of 2004 came around, we started in earnest. A total of 1.45 acres was to be filled to a height of 12 feet above swamp level (100 year flood stage is 9 feet) for the area for the transmitter building, tower bases/tuning houses, guy anchors and roadways to get

to the towers. Because of the height and the fact that the fill actually sunk two feet, we used over 80,000 cubic yards of fill material.



Dump trucks bringing fill material to the WOR property.

After the filling was done, we needed to put in piles to the bedrock at the location of the transmitter building, the guy anchors, the tower bases, and the tuning houses. All of those mentioned sit on steel I-beam piles. The bedrock depth varies across the 40 acre site. In the area of the transmitter building, the depth is 165 feet. As you move east, the depth decreases to 110 feet. At the transmitter building, I had the contractor braise four inch copper strap to the piles in all four corners of the building, a pig tail for inside the building and one for outside the building. WOR has 165 foot deep ground rods going through wet, sticky muck. Perfect.

At the guy anchor locations, a set of piles was put in straight down, and a second set was put in angled. The angled piles were set so that they sloped downward in the direction of guy wire pull, so that the pulling force would be pulling towards the bedrock rather than pulling against a pile driven straight down.



A guy anchor location. Note the angled piles on the left, toward the direction of guy wire pull.

After the piles were in place, the foundations were formed and poured. The slab for the transmitter building alone took eleven trucks of concrete. Bolts to hold the guy anchors and the tower insulators were placed in the forms and welded to the rebar before concrete was poured.



Paul Mucci of Civil Engineering firm Aerial Spectrum checks foundation rebar placement against the drawings before the transmitter building foundation is poured.

## UP GOES THE BUILDING

To save time, WOR decided to put up steel buildings in all locations. This would significantly cut down on the time needed to erect a building, and would provide some shielding in the harsh RF environment that is the New Jersey Meadowlands. It's bad enough that WOR's 50,000 Watt transmitter is on site. We have three Volts per Meter of signal from WINS to contend with, as well as signal from other stations in the area. While the building does not provide complete shielding, it cuts down the RF in the building, and I have not experienced an RF problem with any of the equipment.



The roof trusses ready to be hoisted into place.

At the time the superstructure of the transmitter building was put together, we had the Onan 300

kiloWatt generator delivered and placed on the slab with a crane. I guess you could say that the building was built around the generator.



A worker enlarges anchor holes on the transmitter building support beams.

It was now December, 2004. The building shells were up. Insulation had been applied to the transmitter building interior. Framing had been put up for the bathroom, studio area, garage, generator and utility rooms. The electrician had started roughing in the electrical. But there was a massive leak in the building and the contractor was taking his sweet time. And he had requested that we put the transmitters in the building. After looking at the extremely large puddle of water on the slab, I flatly said “no”.



Insulation has been blown in and the framing is in for the bathroom and studio areas.

I was then extremely involved with the WOR studio project, and the contractor was moving slower. Right before I left for NAB, 2005, I showed up at the building one morning to look at progress to find the contractor nowhere to be found. All his materials and equipment were gone. He had moved out in the middle of the night. As it turns out, he had underbid the job, realized his mistake, and didn't like my response when I told

him we intended to hold him to his contract. After NAB, I started working on finding a new contractor.

## ENTER THE NEW

We ended up hiring a contractor who had performed work for a couple of other stations in the area. I liked his work. He seemed like a good guy. The reviews I got of him were glowing. In the end, there were things that people “forgot” to tell me about him. Like the fact that he had a habit of getting himself in financial trouble and disappearing.

But, we got the building to the point where we could accept transmitters, got the electrical up to snuff, and started construction on what is known as tower number two in the array.



The transmitters and phasor have just been delivered to the WOR site.

## TOWER CONSTRUCTION

Tower construction in the swamp is very difficult. The crew can't simply walk out into the swamp to do things like pull guy wires because they sink in up to their waists. What should have taken six weeks took five months.

A boat had to be used to take the 500 pound guy anchors out to the anchor points. The crew had to be creative in how they ran their load lines, as they couldn't achieve the optimal angles they wanted (and didn't want their winch to sink into the swamp). A crane was used to set the first 100 feet of tower on the base insulator. This 100 foot stub was guy wired in place, and the rest of the tower was built with a gin pole.

What really amazes me about things like towers is that, here we had a 100 foot stub sitting on top of a ceramic insulator with guy wires attached. The weight of the tower sections was approximately 15,000 pounds, and you could probably tack close to 5,000 pounds onto the

weight for the dead weight of the guy wires. Yet, if I grabbed onto the tower and yanked to one side or the other, I was able to twist the tower on its pivot point.



Workers from Northeast Towers remove sections of tower 2 from the delivery truck.

Another problem the tower crew had was the RF in the area. The old WOR site was one-half mile away operating at fifty kiloWatts and putting two Volts per Meter in that direction, WINS was putting three Volts per Meter in that direction, WLIB was putting one point five Volts per Meter in that direction, and WJWR was putting about one Volt per Meter. The site was very hot. And the tower guys were getting belted at various times. It was interesting that the tower wasn't very hot at all until it hit around 300 feet. It was very hot from 300 to 500 feet, then was OK again. And then there were the skirts that had to be put on the towers.

Each of the WOR towers has two wire skirts. The purpose of these skirts is to minimize current flow in the tower at 1010 kHz and 1190 kHz, effectively shortening the electrical length of the tower at these frequencies. Of course, no matter where you jumped the skirt to the tower, which was grounded, they were still warm. The tower crew was glad when tower 2 was complete. The tower was complete around the first of November, 2005.

Meanwhile, after much arguing with the general contractor, who couldn't seem to get the attention of the electrical inspector or the power company, I stepped in and got power turned on to the building so that we could power the tower lights. I also had dialtone installed in the building so we could monitor those lights.



The first one hundred feet of tower 2 stands as the crane is lowered.

## MOTHER NATURE HAS HER SAY

The morning of November 7, 2005, found me with a flu bug. I was supposed to be in Washington, DC for a committee meeting at NAB. Our other two towers were to be delivered to Rutherford this day. But I felt really awful when I got up, immediately sent an email to John Marino at NAB requesting a phone number I could call to attend the meeting via phone, and wandered into the kitchen to get something to eat. My wife had the CBS Morning News on TV, and they were showing images of a tornado that went through Evansville and Newburg, Indiana. Evansville. That name struck a bell with me in my stupor. Then it came to me. That's where our towers were coming from! But, they were supposed to be delivered at 8AM, and it was 8:10AM. No call from the tower crew. I guess things were OK.

Then the phone rang. The tower crew wanted to know if I heard from the tower company because the trucks weren't there yet. I called Steve Savino at Northeast Towers, told him what I was seeing on TV, and said, "they DID get the towers out of there Friday night, didn't they?" Steve tried to call Central Tower (now Tower Innovations) with no luck. A chill went through both of us.

Grabbing a bowl of cereal and a glass of juice, I proceeded to put together a "nest" for myself in the recliner in my home office, then booted up my laptop. It was going to be a long day, even with the flu. By 11AM, I was attending my committee meeting on the

phone and frantically emailing people. I finally managed to reach, via email, the Northeast Sales Manager of Central Tower who stated that “things are a mess there right now and there isn’t much in the yard that survived”. By 1PM, it was confirmed that there was an issue with the trucking company and that the towers were to leave the yard at 7AM Monday morning, November 7. Our remaining two towers had been destroyed in a tornado.

I then emailed our consultant, Tom Jones, along with our FCC attorney, David Oxenford. At this point, Central Tower was picking up the pieces and assessing damage. I had no date, nor could I expect one, for refabrication and shipment of the two towers. It was November, 2005. Our Construction Permit expired in March, 2006. And they are not renewable.

As it turns out, the FCC has a mechanism in place for things like natural disasters which, through no fault of the station and being out of the station’s control, the station cannot fulfill the Construction Permit by the end date. A tornado destroying the towers the day before shipment from the manufacturer fit their definition perfectly. By the end of the day on November 7, 2005, we had filed with the FCC for Tolling of our Construction Permit because of an Act of God, out of the control of the radio station.

### **CONSTRUCTION CONTINUES – MAYBE**

Things had now slowed down on the completion of the building because, with our last two towers destroyed, the pressure was off to get everything done. Our contractor asked if it were OK if he took on a 2 month job building a high-class dog boarding facility, and I said OK. There were things I could do, like getting equipment racks in place, putting the phasor together, getting transmitters put together. But when those two months were done, in January 2006, it was getting hard to get the contractor’s attention. By this time, I had a delivery date for one of the towers for the end of March, so I needed to ramp up and certain things needed to be done, like power needed to be run to the transmitters so I could start testing into the dummy load and align the HD signal.

After much arguing and cajoling, I was finally able to get the electrician in to wire the transmitters. Then the tower came in and erection started. I was wiring the audio racks and transmitters, Verizon put in the fiber and the two T-1 circuits to 111 Broadway, the tower crew freed up a guy to hang the STL dishes on a 50 foot section of Rohn 40 they provided and ran the cables inside (there is a 2 degree aiming difference between Lyndhurst and Rutherford which provided great STL signal). Then, it started becoming harder to get the contractor’s attention.



The WOR twin Harris 3DX50 transmitters, with HD rack in between.

As it turned out, he had gotten himself into financial trouble. Our Construction Permit Tolling stated that the clock on the CP would start running again when the second tower was on site. With the FCC having a New York office, I did not want to have the tower delivered and not inform them it was on site, only to have someone come out and see what was going on, so everything was done on the “up and up”. I was given a date for delivery of the second tower which coincided nicely with the completion of the tower known as number three. The tower showed up and was brought around to the peninsula, the home of tower number one. To get there, we need to travel down the New Jersey Transit railway right of way, and it took almost two days to bring the tower sections over to the location, as we needed to be conscious of trains. I managed to reach our contractor and told him I needed a crane on a particular Friday morning at 8AM. He told me he had no money. I told him again I expected to see a crane at 8AM Friday and hung up.

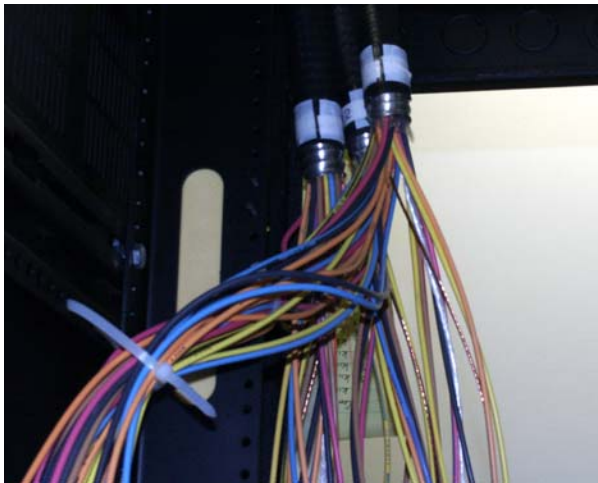
On Thursday, I called the crane company. No crane had been reserved, which was no surprise to me. So I made arrangements with the crane company to supply a crane the next morning with an operator.

On Friday, the crane showed up right on time at 8AM. By 9AM, 100 feet of tower number one was standing. At 9:10AM the contractor decided to show up and had a conniption. I apparently had “no right” to get the job done. He was given his walking papers right then and there. As it turns out, he had not paid the electrician or for the crane when tower three went up, so we took care of the electrician and crane company. When you do that, it’s amazing how cooperative people become. I have no problem getting the electrician in, and the crane company will show up whenever I need them, like when I had to set the 4,000 gallon diesel tank. As of this moment, I was the general contractor.



The 4,000 gallon diesel tank in place.

I spent the next several weeks getting things ready to start the proof. Getting control cables terminated at the towers and inside the building, the cable being a Belden steel armored, PVC jacketed cable rated for direct burial, with twenty 14 gauge wires. Making certain I had the correct transmission line connected to the correct place in the phasor. Verifying I had the sample lines labeled correctly. And taking care of various projects like getting the generator started for the first time, arranging for outside work to be done, getting our station handyman company to take care of other things. By the end of June, I was ready to bring in John Hidle of Carl T. Jones Corporation so we could “fire the mother up”.



The Belden armored direct burial cable, consisting of 20 #14 gauge wires, which was used as control cabling to the tuning houses.

## TUNING AND MATCHING

John Hidle and crew arrived and started putting the finishing touches on the tuning component cabinets in each tuning house. We needed to be a tad creative in getting at least one transmission line into the tuning house and it's first cabinet, but overall, this went

smoothly. The next item on the list was adjustment of the detuning skirts on each tower.



The detuning skirts can be seen, one below the center beacons, one just above where the orange section starts above the beacons. You can also see the capacitor boxes.

Each tower in the array has two tuning skirts made of copperweld cable held out from the tower legs eighteen inches on insulators. These skirts are joined together and bonded to the tower on one end. They are attached to a capacitor enclosure which is bonded to the tower on the other end.

To adjust these skirts, Carl T. Jones Corporation constructed a giant toroidal transformer out of PVC hose. The hose was wrapped with fourteen gauge wire, and the diameter is roughly 9 feet, enough to easily fit around the tower and detuning skirts. The ends of this wire were attached to a BNC adaptor which was connected to a Potomac FIM-41 that the tower crew had hoisted up the tower. NEC modeling showed that the maximum current point in the tower was roughly 250 feet up, right under the sample loop.

The tower crew then set the FIM-41 for the correct frequency, either 1010 kHz or 1190 kHz depending on which skirt they were tuning, then cranked on the capacitor in the capacitor enclosure until they reached minimum indication on the FIM-41. It took two days to adjust all the skirts.

The next step was to detune the towers for 620 kHz, 1010 kHz, 1190 kHz, and 710 kHz, our frequency. While it sounds strange to detune for our frequency, it

makes sense not only for the non-directional Proof of Performance, but for the fact that we can operate non-directional off of any of the three towers in the array for maintenance. While the detuning skirts minimized the current flow in the tower at 1010 kHz and 1190 kHz, the job wasn't finished. What this accomplished was that the electrical height of the towers was reduced at these two frequencies. We still needed to detune at the tower base.

To detune, the tower was grounded, and the FIM-41 connected to the sample line running down from the sample loop on any given tower. The FIM-41 was set to the correct frequency, and the detuning adjustments made to minimize signal on the FIM-41. We were able to achieve close to a complete null on all of the frequencies. Ungrounding the towers had very little effect on the signals being received on the FIM-41, and we took this as the detuning was good. Incidentally, the final settings were not that far off from the theoretical settings.

## FIRING UP THE SYSTEM

Carl T. Jones had preset all of the phasor networks and tower tuning networks. We decided to bring the system up in directional mode slowly, and brought the transmitter up to one kiloWatt, obviously after we had signed the Lyndhurst facility off the air and made sure the Lyndhurst towers were detuned at 710 kHz. We saw that we had ratio and phase on tower number two, but nothing for tower number three. After verifying that the antenna monitor was working correctly by moving the tower two cable to the tower three position, we called it a night.



The phasor, where many a night was spent making adjustments.

The following day showed a short on the tower three sample line, which is what you would expect with the line connected to the sample loop. So we called Northeast Towers who immediately sent a crew down. They disconnected the sample loop, and we were still

seeing a short at the base of the tower. The tower crew removed the connector from the line at the sample loop, and I removed the connector from the line at the tower base. We still had a short. I had a spare coil of sample line, and the tower crew began preparing to remove the sample line from the tower to install a new one.

When John Hidle and I attempted to remove the sample line from the feed-thru bowl on the output cabinet in tuning house number three, we found we couldn't budge the cable. We disassembled the bowl, and it took two strong tower guys pulling on the cable and bowl assembly to yank the sample line out. It appeared we took a lightning strike the day before, it arced over the sample line and welded it to the bowl feed thru, shorting the cable. The tower crew put the connector back together at the sample loop, but the connector in the output cabinet gave us grief. We finally made a nasty splice just to get us through adjustment, and it worked very well.

We came back that night and fired the system up again. Considering we didn't have the final cable run lengths when the system was designed (and the installed version varied slightly), the system came up with tower two being about ten degrees off in phase and about fifteen percent low in ratio. Tower three was roughly the same. Common point impedance was 54 ohms and +j20. Not bad. A little cranking brought the parameters right in and the common point to where it should be.

We then brought the system up to twelve point five kiloWatts and let it cook for about 30 minutes. When all was well, we brought it up to twenty five kiloWatts and let that cook. Finally, we went for the whole magilla and brought it up to 52,650 Watts. All looked good. Then we tried modulating it. The transmitter was most unhappy, so we backed power down to twelve and one half kiloWatts, left it on for about 45 minutes, then called it a night.



Equipment racks at the transmitter site.

## TRANSMITTER ISSUES

WOR purchased two new Harris 3DX50 transmitters for installation in our Rutherford location. These transmitters unfortunately had some minor issues which I needed to work out. First, they were far too sensitive to VSWR, and did not care for the HD signal (or, from the paragraph above, they did not care for regular audio into a slightly funky load, either). I put at least 30 hours into adjusting the output monitor boards on both transmitters before they would operate reliably with HD.



The HD rack sits between the transmitters. Each transmitter has its own HD exciter.

Additionally, what we call transmitter A was set up for minimum settings at the factory, a far cry from how its sister transmitter was set up. Turns out we had a bad backplane for the exciter modules in this transmitter. Once the problems were ironed out, they have performed flawlessly.

## MORE ANTENNA SET UP

The next numerous nights were spent balancing the system and setting the impedances looking into the tuning units to 50J0 on both directional and non-directional operation. After this was done, we proceeded to measure every conceivable parameter under operational conditions and made a record of them. The actual trick was that the impedance would shift when the Antenna Tuning Unit cabinet doors would be closed. We ended up measuring for 50J0

where the transmission lines come into the phasor cabinet.

The Harris 3DX50 is interesting. Rather than disconnect the transmission line between the transmitter and phasor and connect a very low power oscillator to perform an impedance sweep, we simply changed the operating frequency on the 3DX and ran the sweep at one kiloWatt. We found that the VSWR +/- 30 kHz was less than 1.4:1, which meets the IBOC specifications.

The sample system is interesting. We tuned the system up with sample loops, then performed the non-directional Proof. We then went out and did a rough proof on the directional. We found that the pattern appeared it would satisfy the CP, so we went to work finalizing the sample system.

Normally, the sample line comes off the tower and goes through an isolation coil such that the outer conductor at the top of the coil is at tower potential and the bottom is grounded. The bottom then feeds the sample line to the transmitter building. In the case of the WOR system, however, the isolation coils prove problematic. Leaving the coils in the circuit causes two things to happen. First, the detuning on 1190 kHz is not as good as it can be. Second, it narrows the bandwidth of the WOR signal, not good on any count.

After getting the system set up with the sample loops, we then needed to transition from the sample loops to toroidal transformers to feed the antenna monitor. This would take the isolation coils out of the circuits. We did this in three stages.



The base of Tower 3, the tower closest to the transmitter building.

We went one tower at a time, and disconnected the sample loop going to the building from the isolation coil, and connected it to a toroidal transformer placed temporarily over the output pipe. We turned the system on and measured the parameters on the antenna

monitor, then shut the system down. We did this on each of the three towers so that we now had the system running on the temporary toroids and also had a complete set of readings.

We then went to all the towers and, one by one, removed the isolation coil from the circuit, then made slight adjustments to the phasor to return to the readings we started with.

Once that was done and the readings were the same, we transitioned the sample lines to the permanent toroids located in the antenna tuning unit. Once this was done and readings were logged, we removed the temporary toroids and made slight adjustments to the phasor to bring the parameters back in. Mission accomplished.



WOR is inserting Program Associated Data (PAD) into the HD stream through a computer program written by SBE 15 student member Dennis Graiani.

## DOING THE PROOF

Doing Proof measurements in northern New Jersey is a challenge. The close in points for the non-directional proof were a real challenge, as most of them were in the redevelopment area around the transmitter building. It's a challenge dodging dump trucks while you're trying to make measurements. All of the close in points were done with GPS because there simply are no landmarks if we had to do them over again.

The other challenging points were down the train tracks and one that was only accessible by walking one-quarter mile out into the swamp. It was ninety degrees that day, and it was a load of fun stomping out in boots, holding an FIM-41, a GPS unit and a notebook.

The other issues with Northern New Jersey are the simple density of population which makes it hard to move around efficiently, and the suspicious nature of most people. I had a point that I measured several times on a public sidewalk near a house. After the third time I was there, the owner of the house came out and

told me to get lost. I handed him my business card, told him what I was doing, and informed him that I was on a public sidewalk and had every right to be there. He said he would call the cops. I said "go right ahead".

So when the police showed up, I handed them my business card and told them what I was doing. The officer happened to be listener, and said to the homeowner, "he has a right to be here and isn't hurting you." The homeowner became indignant, so I commented to the officer that "perhaps he thinks I'm from the cable company and is trying to hide something. Maybe we should get them out here to run some tests." The homeowner went white and returned to his domicile. Maybe he *was* trying to hide something.

The proof came out fine, and we needed to do a bit of augmenting because of the nature of re-radiation in northern Jersey.

## A QUANDRY AT THE FCC

We were ready to file paperwork with the FCC, but had a problem. Actually, the FCC had a problem. The FCC can't issue a license for the new site or authority to operate until we present them with the "after proofs" on the six other AM stations our antenna system could potentially affect. But we can't do the after proofs until the array in Lyndhurst is taken down.

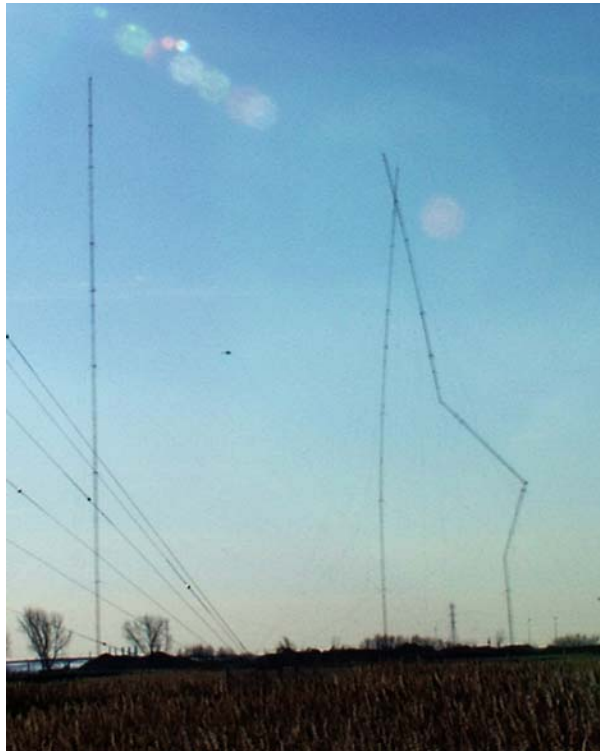
After much discussion between our attorney, Tom Jones and the FCC, it was decided that an STA could be issued to allow operation of the Rutherford facility providing that the filed proof on the new antenna satisfied the FCC and that no interference claims were filed against the new system. We would then be free to take down the towers in Lyndhurst. An STA was granted on September 8, 2006, and operation from Rutherford began full time.

## TAKING DOWN THE TOWERS – NOT

A date of September 20, 2006 was scheduled for demolition of the towers in Lyndhurst. Meetings were held. WOR had not owned the Lyndhurst property for two years, so even though we were the licensee of the towers, it was not our responsibility to make notifications of the demolition. The towers are located in such an area that the New Jersey Turnpike is only  $\frac{3}{4}$  of a mile from the location, and the towers were a landmark along the Turnpike. There is also a 100 year old water main for Jersey City that travels not far from the site, in addition to a gas main, and New Jersey Transit railway. I was assured that all notifications would be given, and we scheduled the date.

On September 20, we had 50 members of the press in New York City and New Jersey assembled, along with

Society of Broadcast Engineers members and invited guests. The towers were to be cut down at 10AM. Unfortunately, the owner of the property had decided that the notifications they were to give consisted of them closing Valley Brook Avenue, the location of the towers, on their own temporarily. WOR was on the air all morning talking about the event, and would be broadcasting it live.



On January 11, 2007 at 11:01AM, the WOR Lyndhurst towers fell gracefully to the ground.

The police chief in Lyndhurst walked into his office at 9AM to a ringing phone. It was the New Jersey Meadowlands Commission who heard us talking about the tower demolition on the air. "Who the hell OK'd this, and who issued an explosives permit?" The chief took off across town to the tower location and put a stop to it. Incidentally, we were not using explosives, and no one seems to know where that came from.

After several months of meetings, building officials, safety officials and the police were satisfied. All notifications went out. News stories hit every newspaper in northern New Jersey, and I must have given a dozen interviews.

On the crisp, clear morning of January 11, 2007, the guy wires were cut on Lyndhurst towers 2 and 3. All the Lyndhurst towers were 689 feet tall, were 42" face, and had dead weights of over 85,000 pounds with guy wires attached. The reason both towers 2 and 3 were taken down at the same time is that one set of guy wires from each tower interlaced. The tower crew did not want either tower to lose momentum on the way down

by getting caught in the wires, or snapping the wires on the opposite tower which could have been catastrophic. So they cut the guy wires on both towers on the legs away from the center of the tower field. Both towers fell gracefully into heaps in the tower field. Total time for all three towers was approximately 35 seconds.



The remains of Lyndhurst tower 3.

The crew then moved onto tower number 1. It did a graceful foldover, hit the ground lawn-dart style, and proceeded to collapse. It is interesting to note that the tuning houses for towers 2 and 3 did not have a scratch on them. Tuning house number one was hit almost dead center by guy wires and looked like a tin can that had a cherry bomb placed under it.



Lyndhurst tuning house 1 was hit by guy wires. The other two tuning houses survived without a scratch.

With the Lyndhurst towers gone, the after proofs could be done and the FCC paperwork finally completely filed.

## **SATISFYING THE RUTHERFORD BUILDING OFFICIALS**

At the time we turned on the Rutherford site permanently, we did not have a Certificate of Occupancy. Very simply, we were playing a game of “Beat the Clock” with time running out on the FCC Construction Permit. I could either pay attention to the building or to getting the FCC work done. If we missed the deadline, the Construction Permit would not be renewed.

Luckily, the state and town officials are the type who want to work with you rather than against you. As of this writing, we are completing several items that the Borough of Rutherford wants done on our building to get their Certificate of Occupancy. We have a temporary CO from the New Jersey Meadowlands Commission with requirements that we install the permanent culvert at the crossing of the waterway into our facility, pave the parking area, and fence the transmitter building compound.

One issue that we still haven’t yet figured out is what to do about E911. The “road” our site is on is a construction road, and won’t be a real town road for at least another year. So we don’t have a street address. As I said to the fire marshal, “this has been in the works for five years – why is it a surprise and a problem now?” We shall see. There are always ways around these things.

## **CONCLUSION**

Completely rebuilding one of the country’s Heritage radio stations in a period of two years has been a challenge. It is definitely something that is not for the faint of heart.



The author, Tom Ray, with the remains of Lyndhurst tower 1. A twisted man with his twisted tower.

facility is completely digital and state of the art. The audio produced in the studio facility is superb.

The WOR transmitter site was designed from the ground up with digital in mind, and in fact signed on with an HD signal (we did the proof with the HD on, as well). The transmitter site has several audio paths from the City, and a studio, complete with call in lines, just in case. Easily, WOR is prepared for whatever may come down the road in the future.

I’m glad I was able to be the one to make it happen.

WOR is now completely new from the tips of the microphones to the tops of the towers. The studio