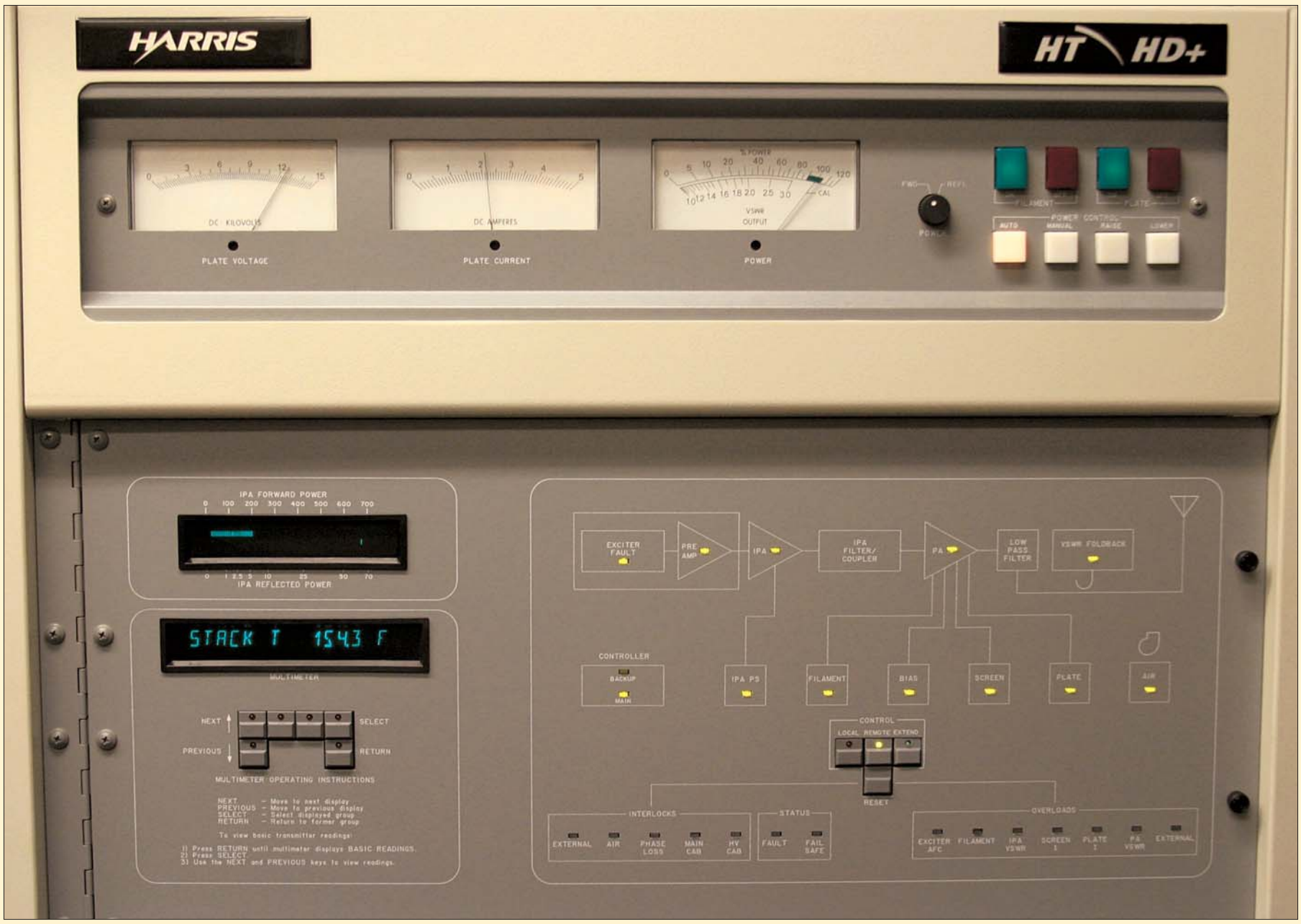
# Radio Guide

*Radio Technology for Engineers and Managers*

October 2006


# Turning Up the Power On HD Radio




## Inside Radio Guide

**Harris' First HT\HD+ Tube Transmitter Goes On Line**

Page 4

Harris recently announced its HT\HD+ high-power tube transmitter, which not only offers cost and space advantages but allows stations to install a single transmitter to maintain both analog and digital broadcasts. WCOL is the first station to go on the air with HT\HD+.

The transmitter is a modified digital version of Harris' field proven HT35, a well-designed, well-built transmitter that has been in the field for over 20 years.

Coupled with Harris' RTAC (real-time adaptive correction) design, this transmitter is achieving higher plate efficiencies that translates to lower power bills, less heat, longer tube life and less stringent AC requirements to cool the room.

# Radio History

by Kevin Webb

## Tesla and AC Electricity
## The Personal and PR Wars with Edison

*2006 is the 150th year since Nikola Tesla's birth. For many, Tesla – possibly the true Father of Radio – remains "The Forgotten Inventor." For that reason, we are featuring a number of articles on Tesla and his inventions. As you will read, Kevin Webb has a passion for the truth about Tesla's life.*

In many industries, fame comes not necessarily to whoever has a pioneering idea or invention, but who was the better "promoter." As examples, the history of the early years of broadcasting is often deemed obscured by the claims of the Westinghouse and AT&T PR Departments for KDKA and WEAF. But, in terms of our story today, it started well before that.

A small warning before we get started: if you are a big fan of Thomas Alva Edison, hang on because this is going to be a bumpy ride. Seriously. Because Edison, "The Wizard of Menlo Park," electrocuted a live fully-grown elephant. Absolutely fried it alive until it could stand no more on its own. On purpose. In front of a huge mob of people and the press.

And he did it all to prove a perverse point: that Nikola Tesla's invention – AC electricity – was evil and dangerous, but Edison's DC power was so very safe. But that is not nearly the worst of it. Get ready to be shocked (pun intended).

### TRUE HISTORY IS NOT ALWAYS PRETTY

While it seems like you might have peeked at the end of this article already, you have no idea as yet what terrible fact climaxes this story about Edison (one of America's "beloved" inventors) and Nikola Tesla.

On the other hand, as you read, it may well dawn on you why Tesla's name largely has been lost to history – and how effective marketing, however cruel, kept Edison's name above that of a genius who was arguably (some would say unquestioningly) the superior inventor.

Keep in mind this is not tabloid gossip or history embellished. In fact, the entire sickening public display was one of the first events recorded with a new technology invented by Edison[1] that captured moving images on film as irrefutable evidence! The scene captured on film was replayed for audiences everywhere. Sadly, Edison apparently convinced the ASPCA that electrocution was a more "humane" way to kill an elephant than by hanging it.

### THE AC DC FIGHT

The reason Edison had Topsy the Elephant murdered with Tesla's AC power in 1903, in front of a wide-eyed mob at Coney Island in New York, was to demonstrate "the horrible consequences of alternating current."

Edison was hoping to so thoroughly disgust people and make them shun AC power that there would be such a huge groundswell of negative publicity and such uproar from the public that no one would dare convert to AC power. 'AC was *not* to be trusted because, well, it is evil! And dangerous! Do not get near it or it will kill you and ruin this country.' Or so Edison wanted everyone to believe.

Edison was quite willing to kill to prove his point. Sadly the elephant was only the *partial* culmination of numerous animals put to death in such a grisly and public display via these staged electrocutions, all in a lurid campaign to smear Tesla's good name.

As you can imagine, there was also a significant amount of money at stake.

### NEGATIVE CAMPAIGNING

When Edison could not argue his point against alternating current logically, he resorted to a smear campaign against Tesla and AC power with scare tactics. "Just as certain as death [AC power] will kill a customer within six months," he declared.

In reality, quite the opposite was true. The DC power infrastructure was so inefficient that DC generating stations had to be placed every one and a half miles. Massive copper cables were required to transport the DC current.

When it rained and the ground became saturated, the large buried cables leaked enough power that horses were electrocuted in the streets of New York City. People were receiving significant shocks as well, some resulting in death, all because the thick DC cables leaked so much power to the earth around it.

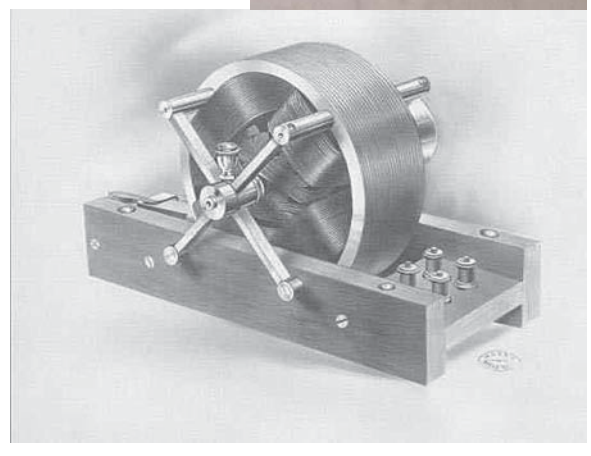
However, the giant PR machine had already snapped into action.

### A DIFFERENT BEGINNING

Ironically, Nikola Tesla was a huge fan of Edison's when he first arrived in the US in 1884 literally fresh "off the boat" as a newly immigrated Serbian with four cents in his pocket.

Armed with a letter of introduction from Charles Batchelor, Manager of the Continental Edison branch in France, Tesla approached Edison to inquire about a job. "I know two great men and you are one of them; the other is this young man," said the letter of introduction. The timing was perfect as Edison had an immediate need for an engineer. Tesla was hired immediately and set out to fix one of many emergencies.

During his introduction, Tesla attempted to explain his theories for alternating current saying it was the wave of the future. Edison's response: "Hold up! Spare me that nonsense. It's dangerous. We're set up for direct current in America. People like it, and it's all I'll ever fool with."

**AC or DC, that was the question.**

### A LONG-STANDING ENMITY

Though Edison admired Tesla's amazing work ethics where he most often worked 18 hour days, this set the stage for their eventual falling out. Edison was simply too financially invested and was too proud to admit AC was a superior system.

As related in an earlier article, Edison offered Tesla a large sum of money to solve a vexing problem. When Tesla, after a year of hard work, solved the problem, Edison reneged on the agreement, trying to turn it into a joke. Tesla literally turned his back on Edison and walked away, forming his own company. Edison never forgot how his former employee "turned" on him.

Edison mistakenly believed that the carbon filaments in his light bulbs would only work best with DC. It took more than twenty years after AC began flowing from the Niagara Falls generating station for Edison to finally admit his error in not understanding AC's superiority over DC.

### TWO INVENTORS, TWO SOLUTIONS

The early debate of AC vs. DC was fast and fierce:

**Nikola Tesla:** "Alternating Current will allow the transmission of electrical power to any point on the planet, either through wires or through the air, as I have demonstrated."

**Thomas Edison:** "Transmission of AC over long distances requires lethally high voltages and should be outlawed. To allow Tesla and Westinghouse to proceed with their proposals is to risk untold deaths by electricide."

**Tesla:** "How will DC power a 1,000 horsepower electric motor as well as a single light bulb? With AC, the largest as well as the smallest load may be driven from the same line."

**Edison:** "The most efficient and proper electrical supply for every type of device from the light bulb to the phonograph is Direct Current at low voltage."

**Tesla:** "A few large AC generating plants, such as my hydroelectric station at Niagara Falls, are all you need. From these, power can be distributed easily wherever it is required."

**Edison:** "Small DC generating plants, as many as are required, should be built according to local needs, after the model of my power station in New York City."

### WESTINGHOUSE ENTERS THE FRAY

George Westinghouse, who made his fortune inventing the railroad air brake, quickly recognized the benefits and potential financial reward of a vastly more efficient method of delivering power to the world using Tesla's AC power. He even shared Tesla's idea of using Niagara Falls hydroelectric potential.

Tesla and Westinghouse worked together to adapt Tesla's single-phase system. Westinghouse's engineers originally chose 133 cycles as the preferred standard. However, Tesla explained this would not do as his original AC motor was designed to work best at 60 cycles. After months of expensive testing the engineers realized Tesla was correct and from that point on 60 cycles became the standard.

Once Edison found out about Westinghouse and Tesla working together to create the alternating system, he was so outraged that he set out to discover or "manufacture if necessary" the hazards of AC current. Personal pride and Edison's ego were at stake, not to mention the fortunes he made from DC power.

### CRANKING UP THE ANTI-AC PR MACHINE

George Westinghouse himself had said "I remember Tom [Edison] telling them that direct current was like a river flowing peacefully to the sea, while alternating current was like a torrent rushing violently over a precipice. Imagine that! Why they even had a professor named Harold Brown who went around talking to audiences ... and electrocuting dogs and old horses right on stage, to show how dangerous alternating current was."

It was Harold Brown, hired by Edison, who wrote a letter to the New York Post describing how a boy was killed after touching a telegraph wire running on AC current.

*(Continued on Page 26)*

# Radio History

by Kevin Webb

## Tesla and AC Electricity

*Continued From Page 24*

Edison's henchmen, including the good Mr. Brown, first began roaming the boroughs of New York in the 1880's, armed with a sheet of metal connected to an AC generator by a pair of wires. Edison paid neighborhood children 25 cents to catch stray animals for this demonstration. Dogs and cats soon began disappearing from around Edison's laboratory in West Orange, New York.

### DEMON-STRATIONS

A small cute little kitten or puppy was placed on the sheet metal. Edison then connected the two wires to the AC generator and announced to spectators, "Ladies and gentlemen, I shall now demonstrate the effects of AC current on this dog." A lethal AC voltage electrocuted the helpless little animal in front of shocked and sickened spectators. It was at these events that the term "electrocution" came to be used.

Eventually full-grown cats and dogs were used, then calves and small ponies and, you guessed it, full-sized horses and cows. The ultimate culmination of the "war of the currents" came about when a murderer on death row in New York State was to be put to death with a new invention called the Electric Chair.

Edison employees Harold Brown (who was a part of the public killings of animals) and newly hired Doctor Fred Peterson designed the first practical electric chair to publicly demonstrate that DC current applied to lab animals left them tortured but not dead. They then applied AC power to show how swiftly AC killed. The electric chair was designed to use AC power and was driven by Edison's desire to show that Tesla's AC was more lethal than Edison's DC.

Doctor Peterson headed the government committee to select the best electric chair design while still on Edison's payroll. AC power was, not surprisingly, chosen as the best method for the state's prison system. Westinghouse refused to sell any AC generators for this purpose (and even paid for the death row prisoner's appeal). Edison and Brown provided the AC generators needed for the first person executed by the electric chair on August 6, 1890.

### PR WORKS

Of course we now know that AC is not "evil" – unless you have been "bitten" while working on an open circuit![2]

It is hard to believe Edison stooped to such a sickening level because of his abject fear (and/or enormous personal pride) that AC electricity would replace Edison's extremely lucrative DC power infrastructure in which his company, General Electric was deeply invested. Yes, *that* General Electric, now known as GE.

Edison's brilliant marketing of himself and his image was so thorough and remembered for the ages that you may still remember him as a kindly, even grandfatherly character that single-handedly created hundreds of inventions. The truth is many of his *employees* actually did the real inventing while Edison simply claimed the credit for the inventions as his own.

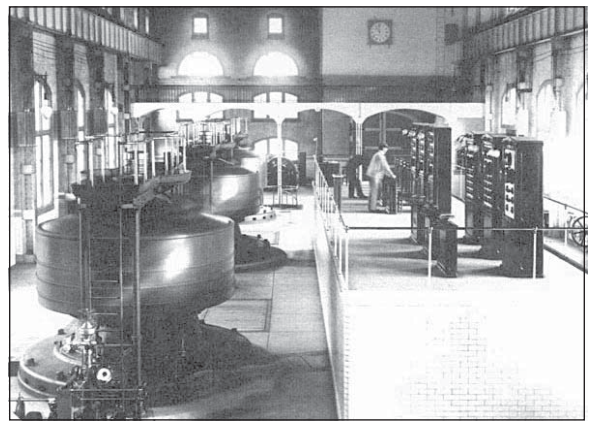
Curiously, *The Smithsonian Book of Invention* completely omits Tesla and credits Edison(!) with the development of today's AC power system. The first edition, written by Dr. Bernard S. Finn, contains many mentions to Edison in the chapter entitled "The Beginning of the Electrical Age" but Tesla's name is omitted altogether.

As a final insult a caption under a picture of the Niagara Falls generating station reads "When the Niagara Falls power station began operating in 1895, it signaled the final major act in the revolutionary drama that began in Menlo Park in the fall of 1879." None of this is true. Yet people have been so brainwashed by Edison's highly effective marketing of himself and his image, Tesla's name has all but been forgotten.

### CRUEL IRONY

Even Westinghouse was recognized for the advancement of AC power which, simply put, completely revolutionized the industrial world and ushered in a new era of convenience through effective power transmission.

In 1912, Westinghouse was awarded the Edison Medal by the American Institute of Electrical Engineers for his "meritorious achievements in the development of the alternating current system." Tesla's name faded into the background.



**The power plant at Niagra Falls.**

One more important fact of history needs to be illuminated: Shortly after November 16, 1896, when the big switch was thrown at the Niagara Falls generating station for the first time, Westinghouse's electric company was ripe for a takeover by the robber barons at that time.

Westinghouse appealed to Tesla asking for a way out of the royalties that were rightfully due Tesla from his inventions. In a generous and history-making gesture, Tesla tore up the contract thus releasing Westinghouse from having to pay a penny. At that point Tesla gave up a huge financial fortune for the sake of mankind.


**Of the 13 patents listed on the Niagra Falls generator, nine belonged to Tesla.**

Tesla so believed in AC power's ability to revolutionize the world that he let go of a contract that would have paid him many millions of dollars. It has been estimated that with the wealth he could have made from his inventions he would have been the Bill Gates of his time. In return, he was often forgotten, sometimes even crudely edited out of pictures – for example, in one with Albert Einstein and Charles Steimetz: http://www.radlab.com/information/tesla.html

On the other hand, Edison was (how shall I say it in a polite way?) *not* a very nice person. In fact Edison's actions in this "War of the Currents" were cruel, evil and vindictive at the very least. Edison's fight against Tesla was certainly based on the fact a lot of money was at stake, but many believe Edison had a personal vendetta against his former employee.

### AN INTERESTING "WHAT IF?"

Just stop for a moment and imagine what could have been accomplished had Edison – who truly was a prescient individual in his own right, even as he appropriated other's work as his own – opened up his heart and mind and worked *with* Tesla instead of against him.

"*Were we,*" remarks B. A. Behrend, distinguished author and engineer, "*to seize and to eliminate the results of Mr. Tesla's work, the wheels of industry would cease to turn, our electric cars and trains would stop, our towns would be dark, and our mills would be dead and idle.*" And that could apply to AC electricity alone, never mind Tesla's more than 700 patents.

And as Paul Harvey would say, "Wash your ears out with this:"

"I do not think there is any thrill that can go through the human heart like that felt by the inventor as he sees some creation of the brain unfolding to success. Such emotions make a man forget food, sleep, friends, love, everything." – Nikola Tesla

Here are some addition reading references and pictures of Nikola Tesla:

- www.pbs.org/tesla/ins/index.html
- www.teslasociety.com/ac.htm
- http://inventors.about.com/od/hstartinventions/a/Electric_Chair.htm
- www.teslasociety.ch/info/CHICAGO_1893/index.htm
- www.teslasociety.ch/info/galerie/bilder/G42.jpg
- www.swehs.co.uk/docs/kphotos/teslamtr.jpg
- www.kerryr.net/images/pioneers/gallery/niagara_falls_lg.jpg

1. Actually motion pictures were invented by one of his employees somewhat against Edison's wishes. Edison thought it was a waste of time and would be of no value. But that is another story for another day.

2. While DC may be a more efficient application of power and perhaps "cleaner" than alternating current, DC current cannot travel over long distances via small cables like AC current can without suffering significant losses through resistance. In time, AC became the transmission standard for public utilities, utilizing voltages of 100 kV and higher, which were transformed down to lower voltages for residential, office or industrial use. Although less efficient, manufacturers had to make their motors and appliances compatible with the national electrical grid.

*Kevin Webb feels Tesla got the short end of the "PR stick," especially from some of Edison's cruel tricks. The General Manager for Tieline Technology in Indianapolis, IN, Kevin can be contacted at kevin@tieline.com*

Here is a clickable list of all the URL's listed in the Radio Guide articles:
**www.radio-guide.com/URL.htm**