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SIGNALS

Rockwell Collins

Monthly Newsletter of the

Amateur Radio Club

Volume 33 Issue 06 **Web Site** http://www.w5rok.us **March 2012**

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RCARC
Membership Meeting

Thursday, 22 March 2012
1700 Social 1730 Meeting
1800 Program

Methodist Richardson Medical Center
At Bush/Renner/Shiloh Intersection
Second Floor Conference Room 200

Subject:

Small Hydroelectric Plant Control - Basic Hydro Plant

by Hernando Garcia-Vasquez – KC5FDW

Local Club News

Meeting Notice Plan to come to the March meeting of the Rockwell Collins Amateur Radio Club, as we hear from our own Hernando Garcia KC5FDW as he presents a unique approach to energy independence.

Rockwell Collins Amateur Radio Club Information Net **Tuesday 20 March 2012** The W5ROK NET meets each month. The particulars are:

WHAT	Information Net - **RCARCIN**
WHEN	Tuesday of the week of the regular club meeting at 19:00 CST
WHERE	W5ROK Repeater 441.875+ PL 131.8Hz
WHO	Everyone and anyone.
FORMAT	(a) announcements (b) Swap (c) Check-in plus updates.

The format provides club and local announcements of interest to Amateur Radio, a swap net time as well as personal updates from net participants regarding their experiences in the hobby. All suggestions for content and format are welcomed. *(Written by Michael Ketchum K5MDK)*

New Radio Tower and Antenna is completed for Boy Scouts at Camp Wisdom *(This is a follow-up to the article in the November 2012 edition of Signals)*
A crew of Hams, including Larry Essary K5XG, spent all day Friday, 2 March 2012, erecting the tower and antenna for Amateur Radio station K5BSA for the Boy Scouts at Camp Wisdom. The camp now has a fine radio station for the local Scouts to enjoy. (*Article provided by Larry Essary K5XG* http://www.K5XG.com)

Poor Man's Amateur Radio Space Program
There has been much discussion, of late, about Amateur Radio Balloon Over North East Texas (ARBONET) and their latest effort coming up this April. The Plano Amateur Radio Klub (PARK) has created a special interest group (SIG) dedicated to building payloads for the upcoming ARBONET-8 launch. This SIG is open to all amateur radio operators, so this is a great opportunity to learn about high altitude balloon launches.

The basic premise for these balloons is a large weather balloon filled with Helium and sent up with a string of payloads that perform different tasks. Some payloads will have HAM transmitters that send *(Cont. on page 3)*

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VE SESSIONS

Dallas tests are held 4th Sat of each month at 10:00. 13350 Floyd Rd. (Old Credit Union) Contact Bob West, WA8YCD 972.917.6362

Irving tests are held 3rd Sat. of each month at 09:00. 5th and Main St. Contact Bill Revis, KF5BL 252-8015

McKinney VE test sessions are held at the Heard Museum the first Sunday of the month. The address is 1 Nature Place, McKinney TX. The time of the testing is 14:30, ending no later than 16:45. ***Note: no tests given on holiday weekends.***

Garland testing is held on the fourth Thursday of each month, excluding November, and begins at 1930 sharp. Location is Freeman Heights Baptist. Church, 1120 N Garland Ave, Garland (between W Walnut and Buckingham Rd). Enter via the north driveway. A HUGE parking lot is located behind the church. Both the parking lot and the Fellowship Hall are located on the east side of the church building, with big signs by the entrance door. Contact Janet Crenshaw, WB9ZPH, 972.302.9992.

Plano testing is on the third Saturday of each month, 1300 hrs at Williams High School, 1717 17th St. East Plano. Check Repeater 147.180+ for announcements.

Greenville testing is on the Saturday after 3rd Thursday, 1000 hrs at site TBA, contact N5KA, 903.364.5306. Sponsor is Sabine Valley ARA. Repeater 146.780(-) with 118.8 tone.

President's Message

I hope your spring weather enables you to get out and do a little antenna tuning or cleanup work outdoors. This week, I found myself on the roof of the house replacing a section of ladder line on my dipole antenna. I'll say a little more on that later.

Well, as we come out of hibernation, there are a couple of projects that you might be interested in. One of them is to get the club surplus ready for sale. We are planning to have a sorting party on Saturday, May 12th and the sale to our club members on Saturday, May 26th at 9:00am. The residual will be sold at Ham-Com in June. The other is the repeater battery purchase and installation. I'm also anticipating some news on the facilities with regards to the Air Handler noise in Penthouse #6. I have not followed up on this effort, but we should be getting a report at the club meeting.

Speaking of the club meeting, I hope everyone plans to attend this month's meeting. We will have an interesting presentation on power grid load balancing from Hernando Garcia-Vasquez – KC5FDW. Also, don't forget about the NET on the W5ROK repeater on each Tuesday before the club meeting.

GOOD NEWS! I've got a new job. On March 12th, I'll be starting at L-3 Communications in Greenville. Although the drive is less to be desired, the prospects of working for gainful employment are too good to pass up. My YL, Amy, is also thrilled at the prospect of me going back to work and getting out from under her feed during the day. I'll be working in the Missions Integration Division on some mission data aggregation projects.

Since I'm seeing my free time (unemployment) coming to an end, I've been trying to get some chores around the house done. One of which was repairing my G5RV Dipole antenna. When it was first installed, I replaced the fixed length ladder line and SO-259 connector with a solid piece of ladder line all the way to the tuner. I've had so-so results with some difficulty tuning to 40m, 80m, and 160m. So, I replaced the straight ladder line length with the original ladder line and coax fitting and ran LMR-400 back to the tuner. With the G5RV back to its original designed specifications, I'm now seeing improved performance on 20m ~ 160m. The radio also tunes up a whole lot better on the upper bands. The moral to this story, stick with the design.

This last Wednesday was the City of Richardson Siren Test. This would have been my last opportunity to participate with the test. However, due to rain and strong winds, they cancelled the siren test. Since I'm leaving the group, there is more than one available siren that needs to be covered for the monthly test. If you are interested in manning one of these sirens, please contact Don Bowen –

K5LHO at don_bowen@sbcglobal.net. The tests occur on the first Wednesday of each calendar month at 12:00pm. Net Check-ins start at 11:55am and the test usually wraps up before 12:10pm.

Thank you for your club participation. I hope to hear you all on the NET and see you at the club meeting this month. Thanks again,

73,
Michael Ketchum
K5MDK
RCARC President

Secretary's Report

23 February 2012

The meeting was called to order by Michael Ketchum (K5MDK) at 5:33PM with the Pledge of Allegiance. Michael introduced Don Eichenberger K0LKX, and Dave Jaksa W0VX with his wife Judy W0JJ. The following were present at the meeting

Ira Blum	K5IRA
Dennis Cobb	WA8ZBT
Don Eichenberger	K0LKX
Dave Jaksa	W0VX
Judi Jaksa	W0JJ
Michael Ketchum	K5MDK
Bob Kirby	K3NT
Steve Phillips	K6JT
Mike Schmit	WA9WCC
Jim Skinner	WB0UNI
Paul Veenstra	KC0TEG
Joe Wolf	N5UIC

General Business
Michael indicated the club net, on Tuesday had two participants, KF5GUN and KE5SAS.

Bob Kirby noted that the club now has on-line banking.

Jim Skinner, Signals editor, asked that photos be e-mailed as separate files so they can be compressed before embedding in the newsletter.

Commemorative Air Force Projects:
Bob Kirby reported that the B-29 departed for its Florida tour the Thursday morning of the meeting. Bob expressed thanks to all the folks who helped out with the B-29 project. These include Lony Duncan, Paul Veenstra, Bill Hulse, Ross Terry, Luis Escobar, Mike Schmit, Jim Skinner and Joe Trcka.

The Long wire antenna, BC-348 Receiver and ART-13 Transmitter are installed and the auto tuner on the transmitter is functional. The receiver is functional, but with some ignition noise observed on 80 meters.

Paul Veenstra and Lawrence Robinson in Cedar Rapids acquired a new transponder antenna for the B-29, The antenna was donated by Granger in Cedar Rapids.

The donated 100 Amp 28 Volt power supply is now available for bench testing the radios and for use as ground support equipment to provide 28 V power to the aircraft during ground work.

Upcoming plans include setting up the P-3 test set as a 1KW HF station. Bob mentioned the possibility of working on the B-24 next.

Old Business:
Station noise issues: Dennis reported that Facilities is planning to change the air handler. We are hoping that the new controllers will reduce the RF noise problem plaguing the club station.

Repeater Power Backup: Michael K5MDK asked for volunteers to help acquire battery power for the repeater.

Surplus Materials: Michael K5MDK stated that he has reserved an indoor table for the club at HAM-COM. We will need a work detail to sort out the surplus material prior to HAM-COM.

The May meeting or some weekend day may be considered for a surplus material sale to club members.

The possibility of donating the MFJ "IT" antenna to the CAF setup at Addison airport was mentioned but not decided.

New Business:
Other Clubs: The Plano Amateur Radio Klub (PARK) is planning a high altitude balloon launch.

Antennas: Mike Kertis might be able to help the club obtain some safety plaques for the roof-top antenna installations.

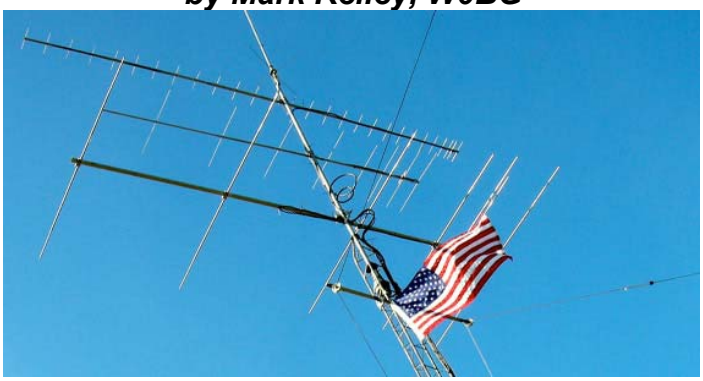
Adjournment: The meeting was closed at 6:09 PM.

Program: Following the adjournment, a presentation on HF DX: "How to work DX. (HF- Part 2)" was provided by Dave Jaksa W0VX.

Poor Man's Amateur Radio Space Program

(Cont. from pg. 1) Hellscreiber or CW beaconing information. Others may have cameras or weather temperature sensors. Most use GPS with APRS to allow tracking. The possibilities are limitless, except that the devices have to survive high altitudes of 100K feet and very low temperatures of less than -60 degrees Fahrenheit. The balloon is a poor man's space program that provides group activity involving many aspects of Amateur Radio. These payloads are comprised of various experiments, some for Amateur Radio purposes and others for pure science. The cost of doing one of these launches is around *(Cont. on pg. 7)*

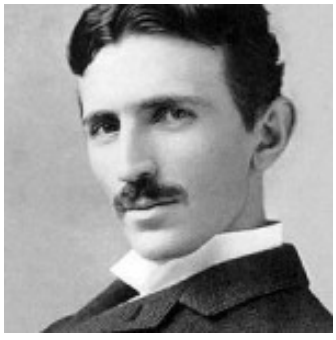
Ham Radio USA – 100 Years and Counting
by Mark Kelley, W0BG



When you first glance at the title, ***Ham Radio USA – 100 Years and Counting***, you can't help but think out loud and ask yourself when ham radio had its *real* start. If ham radio in the USA really is to have its *centennial* celebration this year, that necessarily means that we're assigning the year 1912 a great deal of significance. For the purposes of this article, we'll focus on the formative years of ham radio and leave the modern for another discussion at another time.

For now, let's look at many of the events leading up to this special year for the ham operator. Certainly, a lot of things had to happen to lead to this momentous year. And whether or not this is a year that hams of other nations should choose to celebrate, well, that's certainly a matter of choice and national pride. Nevertheless, none of us would have little to celebrate, were it not for the great sacrifices of so many great spirits from all over the globe. Work of the world's brightest scholars and experimenters paved the way for studies in electromagnetic theory, like that of **Guglielmo Marconi** and **Nikola Tesla** who were able to present their groundbreaking theories, ultimately giving birth to ham radio and putting our hobby on the map.

Guglielmo Marconi, born in Bologna, Italy, 1874



Nikola Tesla, Born 1856, Smiljan, Austrian Empire (Croatian Military Frontier)

No doubt there are many of us who have been asked regarding the origin of the word "ham," a word which has come to define our hobby. Although you may not take this as the final word on the subject, you will find this particular interpretation interesting, as there would seem to be no reason to doubt its authenticity. The word ham actually appears in the publication "The Telegraphist" in September of 1884 when referring to a not so good telegrapher as a "duffer" or "ham." The word "duffer" may be defined as an incompetent or clumsy person, one with little professional training or experience. Although today we take great pride in being called a ham in 2012, being called a ham, at least in the context mentioned here, was unflattering and derogatory at best, during the day of the land line telegrapher of 1884 per this particular citation.

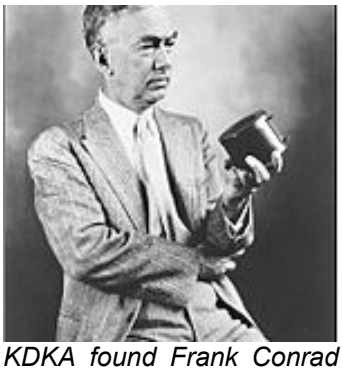
Guglielmo Marconi and **Nikola Tesla** paved the way for early ham experimenters, after having successfully transmitted and received signals over distances of several kilometers. **Tesla** achieved this feat in 1895, as he was able to receive transmitted signals from his lab some 80 km away at *West Point, New York*. **Marconi** accomplished a similar feat actually using Morse Code in 1896 by transmitting signals over a distance up to six kilometers on *Salisbury Plain, England*.

Signal Hill, New Foundland, 1921

Marconi reported sending signals across the *English Channel* in 1899. It wasn't long after that Marconi made the announcement on 12 December 1901, using a 152 meter kite-supported antenna for reception, that he received a message of sorts at Signal Hill in *St John's, Newfoundland, Canada*. The received signals were transmitted by the company's new high power station located at Poldhu, Cornwall, Great Britain. The distance between the two points was about 3,500 kilometers (2,200 mi). Heralded as a great scientific advance, there was—and continues to be—some skepticism about this claim, partly because the signals had been heard faintly and sporadically. There was no independent confirmation of the reported reception, and the transmissions, consisting of the morse code letter S sent repeatedly, were difficult to distinguish from atmospheric noise.

The first true pioneers of ham radio began making their mark sometime after 1908 following **Marconi's** experiments (1900-1908). Morse Code by use of spark gap became the transmitting mode du jour and remained as such until sufficient numbers of amateurs had home brewed their first AM transmitters. To the best of this author's understanding, the earliest voice type transmission took place

Christmas eve in 1906 and was made by **Reginald Fessenden**. This event is still disputed to have taken place. **Charles Herrold** began broadcasting actual audio programming in *California* in 1910 on a station he built which went on to become KCBS.



KDKA found Frank Conrad with mic in hand

For the next decade, hams and experimenters alike continued to tinker with AM transmitters and receivers. Certainly, by 1918 and the development of the superheterodyne receiver, we were well on our way as technology continued to gain ground. PCGG in the *Hague, Netherlands* began broadcasting on November 6, 1919. In 1916 a man by the name of **Frank Conrad** began transmitting from his home in *Wilkinsburg, PA* as an employee of Westinghouse Electric with the call letters 8XK. This station relocated on November 2, 1920 to become KDKA, the world's first commercially licensed broadcast station. It's important to discuss the formative stages of commercial broadcast radio in conjunction with the history of ham radio, as early hams played a key role in the development of emerging RF technologies, associated with both commercial and non-commercial applications.

A lesser known fact is an act of congress which allowed amateur experimenters to take part in research and development of early technologies. In 1910, *Senator Chauncey Depew (NY)* introduced a bill before the United States Senate which would have prohibited experimentation by amateur radio operators, while fearing that these hams would cause communications interference to the US Navy. Fortunately, this bill was defeated.

The year 1912 is significant to the US and certainly to a degree to amateur radio worldwide. This was the year that ham radio achieved a true level of legitimacy. Considering that our group of noble experimenters and communicators had already come under attack in 1910 by an attempted legislative act to summarily snuff us out, the fact that ham radio operators as a group were recognized, the fact that laws and rules were put in place to regulate operation, designate frequencies and introduce licensing truly gave impetus to our fledgling hobby, while recognizing our contributions to the growth of radio technologies.

For this we can thank the *Radio Act of 1912*. During the period 1910-1913 the *United Kingdom* began issuing amateur radio licenses. In addition – *Canada, Australia, France* and *Argentina* developed government organizations responsible for the regulation of amateur licensing and the adoption of rules for amateur radio.

Radio room with spark gap transmitter on board the RMS Titanic, launched 31 May, 1911

We owe the *British* government our thanks for creation of the original Q-Codes in 1906. These codes were initially developed to facilitate communication between maritime operators representing a multitude of countries and speaking a variety of languages. There were originally forty-five codes representing abbreviations of potential questions or responses included in a list used for radio communications. These were part of the Service Regulations which served as an attachment to the Third International Radiotelegraph Convention in *London*, signed on July 5, 1912. Interestingly enough, the Amateur Radio Relay League began their ham radio publication called QST only three years later. These codes have been modified over the years. When in use in 1913, QSW/QSX meant: "Shall I increase/decrease my spark frequency?" Spark Gap was banned as a mode in the *United States* in the 1920s.

The first international amateur prefixes were defined by convention in 1913 as part of the London International Radio Telegraphic Conference after signing at the International Bureau in *Berne, Switzerland*. That initial list was much shorter than the one in use today. As a point of interest, the initial prefixes A, D, Y and KAA-KCZ were allocated to *Germany*. The *US* was allocated W, N and KDA-KZZ. *England* was assigned B, G and M. *France* was assigned F and UAA-UMZ. *New Zealand* was the recipient of VLA-VLZ. Consider how different some of our QSL cards might look today if these prefix allocation conventions had remained the same.

By 1914 the *ARRL* had been organized and developed the beginnings of the National Traffic System. By this time the *RSGB (Radio Society of Great Britain)* was already in existence having taken root in 1913. Clubs had already been formed in *France* and *New Zealand* and there were already 6,000 hams worldwide.

By 1915 some of the first DX contacts had been logged. Between 1919 and 1926 another 55 countries were added to DX rosters, as the amateur radio hobby continued to

grow. During World War I ham operators were forced to go QRT, as CW keys and microphones were silenced for the duration of the war. Such was also the case during World War II. This new RF technology found itself being used for the first time on the battlefronts, as the worlds greatest minds continued to research the properties of electromagnetism. The picture above is a quite famous one. Amongst others, it includes **Guglielmo Marconi**, **Nikola Tesla** and **Albert Einstein** at *Somerset New Jersey Station*, 1921.

1923 marked the first recorded transatlantic DX contact between licensed hams. *American* hams 1MO and 1XAM logged QSOs with 8AB of *France* on 110 meters. In case you're curious, the first DXCC was awarded in 1937. The *International Amateur Radio Union* was formed in 1925 and began awarding its first WAC (Worked All Continents) awards in 1926. At that time ham radio already boasted some 30,000 loyal to the hobby. The year 1927 marked the creation of the *Federal Radio Commission*, when the *Radio Act of 1912* was superseded by the *Radio Act of 1927*. It's in 1927 that you began seeing the first references to amateur radio operators. By 1928 the *IARU* had organized itself into an association of national societies.

The year 1926 marked a great year for antenna research. The tops of most ham radio towers might look significantly different had it not been for the work of *Japanese* researchers Shintaro Uda and Hidetsugu Yagi. From the labors of their epic research was born today's modern beam, the once so named Yagi-Uda Array. Although Hidetsugu Yagi played a lesser role in the antenna's development, the name "Yagi" is the one that stuck and antenna manufacturers everywhere don't seem to mind.

Shintaro Uda, co-inventor of the Yagi-Uda Array, born June 1, 1896

The year 1929 marked the end of the roaring twenties and the beginning of the structure of bands as we know them today, minus the WARC bands and other additional frequency allocations. In 1929 international "experimental" bands came into being, as amateurs worldwide welcomed 160, 80, 40, 20 and 10 meters. This was the result of the *International Radio Conference of 1927*. You'll note that 15 meters is absent from these bands, which are all harmonically related wave lengths of one another. The 15 meter band was introduced in 1947 at the *International Radio Conference of Atlantic City* in New Jersey. This was done in part due to the loss of 160 meters to Loran during World War II. 15 meters actually became available to US hams, CW operation only, on May 1, 1952. The band became authorized for phone transmission on March 28, 1953 above 21.250 Mhz.

All US hams should be familiar with the year 1934, the year that the Federal Radio Commission was put to rest, leading to the establishment of the *Federal Communications Commission* or *FCC* . That same year the *FCC* came out with the now famous *Communications Act of 1934*. Most of part 97, as we know it today, traces its origin to this original draft. Although changes have been made since its initial creation, we owe a great deal of our ham spirit and vision today to the crafters of this document, defining the rules and framework in which we should operate.

There are so many things which have not been mentioned in this article and should have been. In celebrating 100 years of our hobby, we could write enough to fill volumes. As we've focused on the early days of our hobby only, it's obvious to everybody that much has been omitted. Perhaps in the comments section of this website you'd like to draw particular attention to some of those things that are special to you or those ham radio moments which have made an indelible impact on your life.

For this author, a special QSO comes to mind. It was 1972. I was a high school student then on 20 meter CW, pounding away on an old Vibroplex Lightning bug purchased from another ham who had used it while a CW operator in the US Navy. I was in the middle of a good old-fashioned rag chew with an OM in California, from the city of Santa

Rosa, just north of San Francisco near the Golden State's wine country. My grandfather, Eugene Ladd, lived there. He had wanted to be a ham operator, but in his final days with emphysema, he didn't have the energy to learn the code. He had a mobile home full of radios of all kinds. His most prized was a Radio Shack DX-150A which he used as a short wave listener. He loved tuning into the ham bands. Well, after a good hour of rag chewing on CW with my new WB6 friend, I asked him if we could QSY to SSB for a phone patch with grandpa. He told me no, whereupon I was bold enough to ask him why, at least three times. My brass pounder friend told me he was blind, deaf and mute. I proceeded to ask him how he copied my CW. He explained, "I removed the cabinet to the speaker. I've got the volume up high so I can feel the pronounced vibrations of your code through my fingertips." I wept humbly knowing that I was one of a select few who could converse with this dear OM near the California coast.

One of the founding tenets of *DxCoffee* is a belief in the founding principles of amateur radio. This article would truly be incomplete without quoting these principles found in *FCC part 97* of the *Communications Act of 1934*. They are true principles for all hams, not just those of the United States of America:

(a) Recognition and enhancement of the value of the amateur service to the public as a voluntary non-commercial communication service, particularly with respect to providing emergency communications.
(b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.
(c) Encouragement and improvement of the amateur service through rules which provide for advancing skills in both the communication and technical phases of the art.
(d) Expansion of the existing reservoir within the amateur radio service of trained operators, technicians, and electronics experts.
(e) Continuation and extension of the amateur's unique ability to enhance international goodwill

It's this writer's strong conviction that we should have these five principles framed and prominently displayed at our operating stations, as a permanent fixture in our shacks, reminding us of who and what we are. These great words should serve as constant reminders to us of our commitment as hams to the Amateur Service, to one another, to those yet to become future hams, to those new hams in need of an elmer, to those operators not as skillful or technically savvy as we are, to those still a little rough around the edges. Let these words remind us that we are to build international goodwill and tear down those walls that divide and separate. During the most intense of contests and the most fearsome of pileups, let us remember who we are, in gratitude for those great OMs and radio pioneers who went on before us.

With gratitude to the late AC6V and LY2YR whom I have used, in great part, as sources for this article.

About W0BG Mark Kelley has written 104 posts in this blog. I've been a ham for 41 years, having passed the exam for my Novice license when I was 14 years old. I've always enjoyed working DX, especially on CW. I also have a passion for foreign language. Many of my German friends remember me as DJ0BG when I was a student in Regensburg. *(Reprinted by permission from Mark Kelley W0BG at the website,* http://www.dxcoffee.com*)*

Monday Ham Lunch in Plano—New Location

WHEN: Each Monday at 11:30 AM.
WHERE: Great Wall Chinese Restaurant is at 901 W. Plano Parkway in Plano. (972) 578-8702, just east of Alma.
WHO: Lots of new and long time hams from the DFW area. Sometimes visitors from other call districts

Poor Man's Amateur Radio Space Program

(Cont. from pg. 3) $400.00 plus payload equipment.

After the initial planning and the construction of the payloads, the launch is organized. There are various roles represented, which include a Launch Director, Payload Manager, Weather Officer, Balloon Tracking Officer, Fill Team Manager, Mission Control Manager, Liaison to the FAA, Data Collection Team, Public Relations Coordinator, Photographer and Recovery Team members. After planning and training meetings, the launch date arrives with much anticipation. The balloon is filled with Helium and, after meeting launch criteria and FAA notification prior to and throughout the flight, the balloon is launched. When the balloon reaches high altitude, sometimes around 100,000 feet, the balloon will burst due to the vacuum of space and the payload falls back to earth. Recovery teams are responsible for the recapture of the payloads. Aerial support is also used, when pilot and aircraft are available to participate. The payloads may travel one to two hundred miles from the launch site, so tracking is important.

The next launch is planed as ARBONET-8 and is scheduled for April 7th. The launch site will be Hillsboro Airport, provided the weather and the FAA cooperate. You can find out more by joining the Park Balloon SIG yahoo group at http://groups.yahoo.com/group/PARK_Balloon. You can also learn more about ARBONET and other projects at www.arbonet.net, www.arhab.org, or www.eoss.org. The next milestones for this launch are March 17th for design review and March 24th for stack testing. A launch results review will take place on April 21st at the Plano Super Bowl at 9:00am to present results and discuss lessons learned. If this sounds like something you want to participate in, then sign up and get involved. *(By Michael Ketchum K5MDK)*

Rockwell-Collins

Amateur Radio Club

Mail Station 461-290

P.O. Box 833807

Richardson, TX 75083-3807

TO:

CLUB STATIONS
(972) 705-1349

W5ROK REPEATER
441.875 MHz +5 MHz Input
131.8 Hz PL - RX and TX

W5ROK-1 PACKET BBS ROK Node
145.01 MHz

W5ROK-N1, W5ROK-N2 & W5ROK-N3 HSMM-MESHNET Nodes 2.4 GHz

Thursday, 22 March 2012

1700 Social 1730 Meeting

Methodist Richardson Medical Ctr
At Bush/Renner/Shiloh Intersection

Second Floor Conference Room 200

NEXT SIGNALS INPUTS DEADLINE:
→→→ 15 April 2012 ←←←