

Amelia Earhart's Radio Communication System

Experimental Airborne HF Tests

BACKGROUND

We are a team comprised of pilots, engineers, scientists, and marine archaeologists who are working together to solve the last great mystery of the twentieth century: The location of Amelia Earhart's Lockheed L-10E aircraft lost in the Pacific Ocean in the vicinity of Howland Island in 1937.

Why is it important to find Earhart's aircraft? Amelia Earhart represents part of the fabric of what it means to be an American. She was a risk taker who broke barriers for women to enter a field that was largely dominated by men. As an adjunct professor at Purdue University, she encouraged a generation of women to enter the then fledgling field of aviation. When she was the first woman to fly across the Atlantic solo, women woke up to new possibilities and opportunities that women could pursue. Even today women find the example of Earhart an inspiration.

We are committed to locating the L-10E, documenting the historical site, recovering and restoring the aircraft. We have been working with Ms. Dorothy Cochrane, curator for the Commercial Aviation side of the museum for the last 20 years. And from the publicity generated by finding Earhart's aircraft, we will use that momentum to inspire more young students to pursue STEM careers.

Since 1999 extensive study and analysis by Rockwell Collins engineers has focused on determining the technical parameters and performance of each system component comprising Earhart's HF communication link. This was initially accomplished by computer modeling followed by experimental measurements on each system component e.g. transmitters, antennas, propagation, and receivers. As a result, the final distance computation between the Electra and USCG Itasca is subject to the combined statistical variations associated with each system component.

By recreating the total HF communications system as accurately as possible, and then measuring the end-to-end system performance will reduce the statistical variation of the previously obtained results. Until recently, obtaining and restoring all of the scarce 1937 equipment prevented such tests. We are now in a position to accomplish such a test.

FCC Executive Summary for Airborne 3105kHz Experimental License

REQUEST FOR EXPERIMENTAL STA

The purpose of this STA application is to request FCC authorization to transmit on an airborne HF frequency utilized by Amelia Earhart and the USCG Itasca. The transmissions will be short duration AM voice messages read from the transcript of Earhart's last HF transmissions. The frequency of interest is 3105kHz. We request the use of 3096kHz, which is close to Earhart's original frequency but off of 3105kHz.

Earhart transmitted with AM (A3E) voice on 3105 kHz at 20watts output and was received by the US Coast Guard cutter Itasca at 0615, 0645, 0742, 0758/0800, and 0843 Itasca Standard Time (IST).

We understand that such authorization would be granted on a short term, non-interference basis as a secondary use. As such the operators will listen on the frequency prior to transmitting to ensure the frequency is clear.

STA LICENSE VALIDITY

We request that the license be valid for 30 days.

Having requested the 30 day validity, our plan is to integrate and test the end-to-end system over the course of two weeks. The actual test will be accomplished over the ocean east of Norfolk, Virginia on one or two separate mornings.

We expect the total over-the-air time to be less than 6 hours for each frequency between August 21, 2020 and September 21, 2020.

COVID-19 Contingency Planning: Given the uncertainties associated with **COVID-19**, if the tests are postponed, we are requesting the ability to shift the start date for the STA license authorization providing a 10 working day advance notification to the Commission of such postponement.

RADIO OPERATOR QUALIFICATIONS

The radio operators on both ends of the HF link hold current FCC Extra Class amateur radio licenses:

Roderick Blocksome, K0DAS

Rod has 60 years as an active licensed amateur radio operator (K0DAS – Extra Class). He holds BSEE & MSEE degrees. He served 4 ½ years as a USAF Comm Electronics Officer during the Viet Nam war era. He retired from Rockwell Collins (now Collins Aerospace) after 42 years in Design Engineering and Management. Since retirement, he serves on the board of directors of ARRL – the national organization of amateur radio and the Arthur A. Collins Legacy Association.

During his career at Collins, he held key engineering roles in many HF communications products and systems – most for U.S. Government Agencies and DoD. Some relevant systems are: National HF Comm system for FEMA, Redesign & relocation of Collins' Comm Central HF Station with services leased to U.S. Customs & Border Protection & USCG, Commando Solo EC-130 Systems, F-22 CNI System, High Power HF transmitters for U.S. Navy Shore Stations worldwide, USAF Global HF Systems upgrade, and many others.

Rod was honored as a corporate engineer-of-the-year in 2002.

He represented Rockwell Collins on US MIL-STD-188-141 Technical Advisory Committee, the Beyond Line-of-Sight Ad Hoc Working Group (HF Communications Standards for NATO), and the High Frequency Industry Association (HFIA). He served as chairman of HFIA for 2 ½ years. Rod is the author of many technical papers and articles, including chapter 12 on solid state HF power amplifiers in *Single-Sideband Systems and Circuits* published by McGraw-Hill. Many of his papers were presented at technical seminars and conventions and two were published in *Classic Works in RF Engineering*, 2006, by Artech House.

For the past 20 years Rod has donated his time and skills toward finding Amelia Earhart's airplane lost at sea in 1937.

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Thomas Vinson, NY0V

Tom is a graduate from Southern Illinois University with degrees in Electronics and Industrial Engineering. He earned a Master's degree in Business from Iowa State University while working for Rockwell Collins, Cedar Rapids IA. His career at Rockwell Collins (now Collins Aerospace) spanned 35 years in their Operations Engineering and Program Management organizations. In program management he was responsible for the USAF airborne ARC-190 High Frequency Communications System, USAF MILSTAR EHF/SHF Satellite System components, MIDS L Band Link 16, and retired while leading the Advanced Networked Datalinks business area.

He is presently on the Board of Directors of the Chosen Valley Community Foundation, as well as SeaWord, Nauticos Corporation's non-profit educational foundation.

Over the last 20 years Tom has provided communications support to Nauticos on three deep water SONAR searches to the Pacific. He utilizes his experiences on the expeditions as a spring board to provide Earhart Search STEM presentations to schools, civic and professional organizations, and various amateur radio clubs.

He is active in his 54th year in amateur radio (NY0V- Extra Class) where he enjoys CW, DXing, contesting, and modifying antennas to improve his station's performance from the HF 160m band up through 23cm.

Bryan McCoy, KA0YSQ

Bryan holds a BS in Electrical Engineering and a BA in Industrial Technologies, both from Iowa State University. He retired from Rockwell Collins (now Collins Aerospace) after thirty years as a Principle Engineer in the Flight Controls (autoflight) department and the Advanced Technologies department. He is currently back on contract to Collins in the Advance Technologies department developing high data rate government secure radio platforms.

During his career at Rockwell Collins, he served as a design engineer working on the Boeing autopilot designs for the 747, 757, 767, 777, and 737 NG platforms as well as the Fokker 70 and 100 platform. During his Flight Controls tenure he represented Rockwell Collins at the RTCA SC-135 special committee for four years, working specifically in the DO-160 lightning, radiated / conducted RF emissions and susceptibility groups. In the Advanced Technologies department he worked multiple DARPA programs collecting nine US Patents in multiple areas. He is the recipient of Rockwell Collins Good Citizenship award acknowledging humanitarian relief effort projects in America and abroad.

For twenty years Bryan has donated time, material, and skills including on-ship contributions to Nauticos during their deep water SONAR search in 2017. His other interests include alternative energy having operated a personal bio-diesel processing plant for ten years. His recent installation of 7.2KW of solar photovoltaics contribute to his daily energy use and his wife's plug-in hybrid car. He is a current mentor to the Iowa State Solar Car team, having traveled with the team to Australia in their recent World Solar Car Challenge. He also mentors with Coherent Photon Imaging, an Iowa State start-up company in their development of a non-

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destructive materials testing platform using laser ultrasonics. Bryan continues to write quarterly for the Iowa BMW car club focusing on repair challenges of older vehicles. He participated in the 100th anniversary of the military vehicle caravan crossing the United States on the Lincoln Highway in a 1945 GPW jeep.

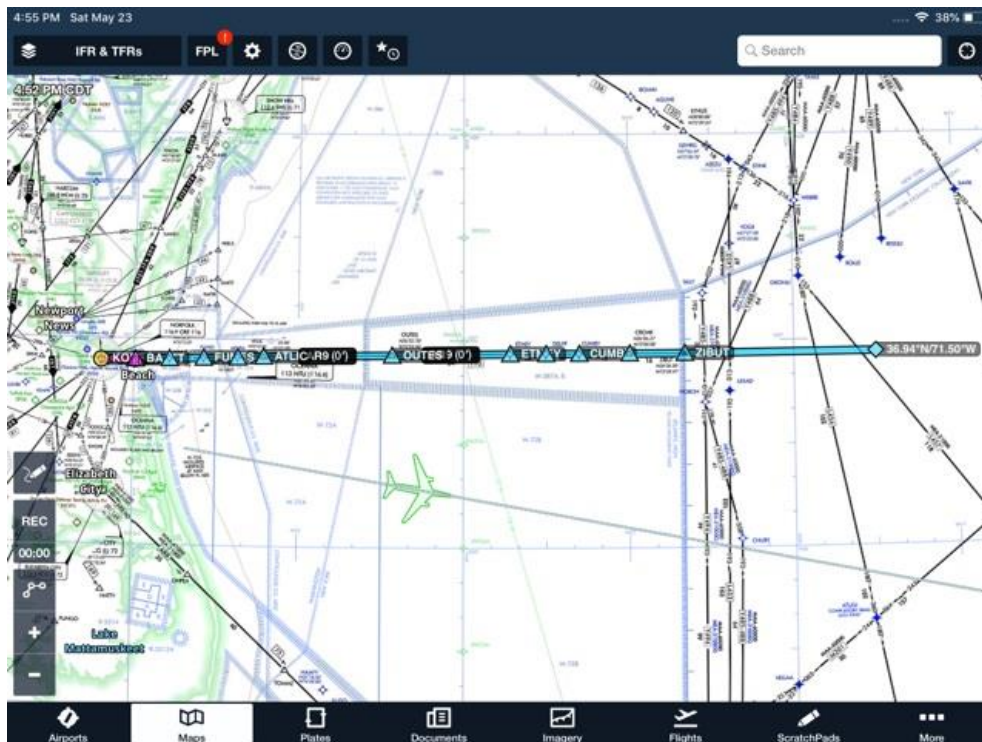
Bryan has over thirty eight years as a licensed Amateur radio operator (KA0YSQ – Extra Class) and is active in Amateur Radio using home built equipment from VHF to 10 GHz.

LOCATION OF STATIONS

Airborne Station Location:

The integration of the HF on the Beech 18 (Registration N18G) aircraft will be held at Dynamic Aviation of Bridgewater, VA. The flight test plan calls for the 20watt output (~3w EIRP) AM voice transmissions on 3096kHz.

Following the successful integration of the HF system, the actual flight experiments will be held by flying out of Norfolk, VA east over the Atlantic for 379km (200nm) via Air Route 9 and returning via the same air route. A fixed station on the ship the “Nellie Crockett” will be the receive site for the 3096kHz AM voice tests.



Flight path for the Beech 18 N18G along AR9 out of Norfolk with transmissions on 3096kHz AM voice

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Seaborne Fixed Station Location:

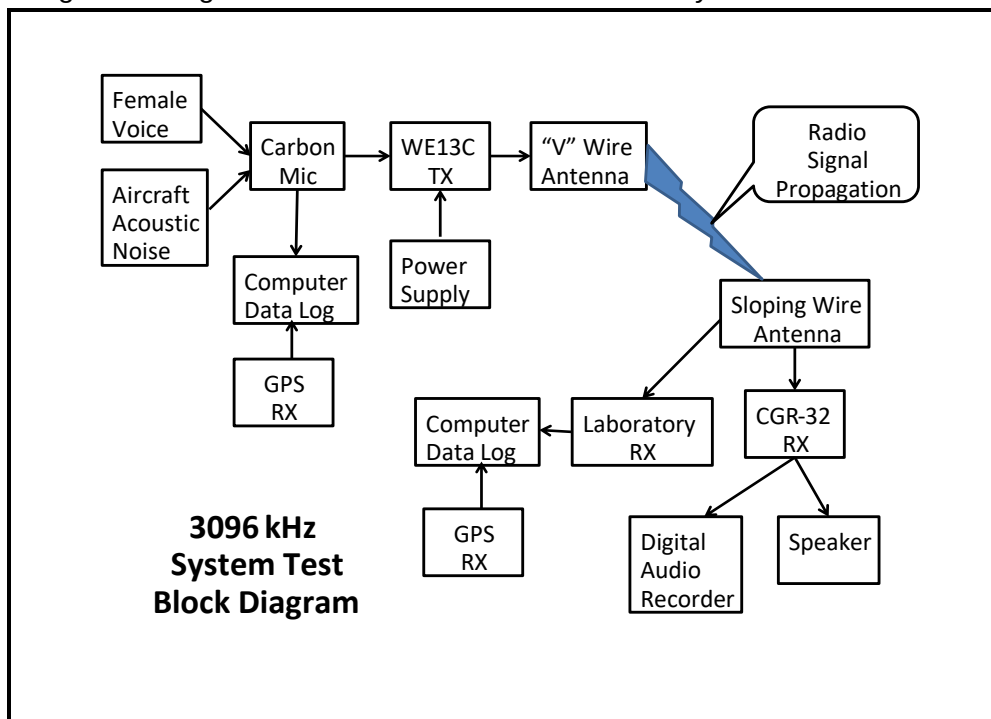
The receive site location will be on the ship Nellie Crockett. The ship will be station keeping at 5.5km (3nm) east of the Cape Charles, VA lighthouse. The coordinates are 75 degrees 50' West, 37 degrees 7' North.

THE COMM SYSTEM LINK – 3096 kHz

The major communication system components for 3105 kHz are summarized as follows:

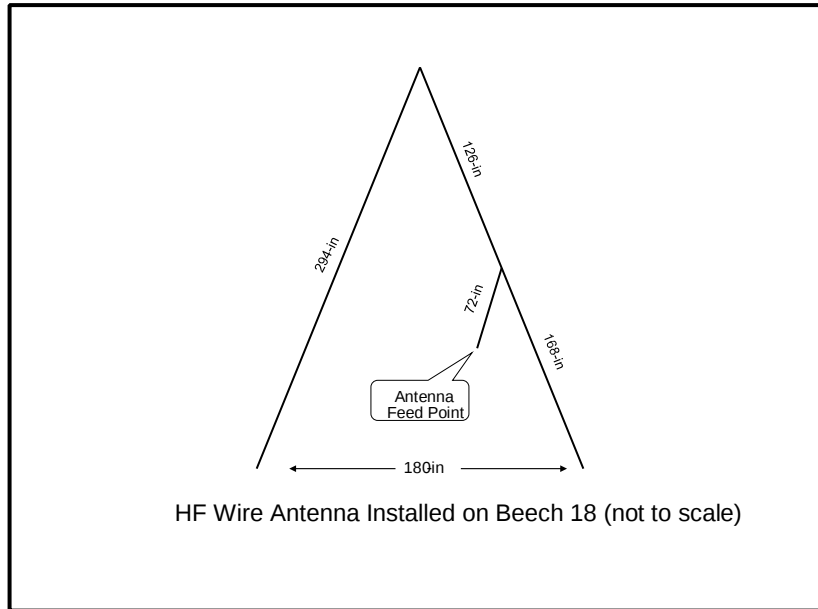
1. Aboard the “Electra” (Beech 18 N18G) aircraft – Female operator’s voice, aircraft acoustic noise, vintage carbon microphone, Western Electric 13C 20watt output AM (A3E) transmitter, aircraft “V” wire antenna above fuselage.
2. Aboard the Nellie Crockett “Itasca” ship – Sloping 15.2m (50ft) wire antenna, RCA CGR-32 receiver, experienced radio operators.
3. Test Environment – Aircraft flying from 2134m (7,000ft) to 305m (1,000ft) altitude during early morning hours with a continuous salt water path of up to 370km (up to 200 nm) between aircraft and surface boat. GPS based data logging for accurate time and position plus digital audio recording at both transmitter and receiver.

The following block diagram further illustrates the 3096 kHz system:



ANTENNA CONFIGURATION AND POWER OUTPUT PARAMETERS

3096 kHz Aircraft Wire Antenna Dimensions



In this antenna configuration and transmitting on 3096kHz, the predominant part of the antenna that is radiating is the 1.83m (72") vertical feedline. The "V" is 7.5m (294") on each side. The "V" acts as a capacitive load.

The antenna gain of this HF antenna on the Beech 18 ranges from -4.6dBi to -10.7dBi. This variation is due to the shadowing effect of the fuselage and the left vertical stabilizer. The higher gain is in the forward/nose direction. The lowest gain is off the port side vertical stabilizer of the aircraft. If desired, the NEC4 modeling of this antenna is available upon request.



Amelia Earhart's L-10E showing the DF Loop and Transmit "V" Wire Antenna

Contact Information:

For correspondence related to this request please contact:

Tom Vinson
31000 US 52 S
Chatfield, MN 55923
Email: tnvinson1@gmail.com
Cell: (319) 899-8779

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Summary

The HF test we are proposing to conduct will reduce the variation in the HF communications link analyses. That in turn will enable us to narrow down the search area for Amelia Earhart's L-10E Electra. The outcome could solve the last great mystery of the 20th century. What happened to Amelia Earhart and her navigator Fred Noonan on that fateful day of July 2nd 1937?

We respectfully request approval of a 30 day STA to transmit on 3096kHz commencing August 21st with integration and test. In addition, due to COVID-19 uncertainties, we request the ability to move the 30 day window on the condition that we notify the Commission within 10 working days of the postponement of the tests.