Modification of the LF Transmit Site at Dixon to Support RF Propagation and Ionosphere Research

Doeg Rodriguez[(1)], Nicholas Lumdsen*[(1)], Peder Hansen[(2)],
Laura Lukes[(3)], Jill Nelson[(3)], KC Kerby-Patel[(4)], Filip Crowov[(4)], William Liles[(5)],
and John D. Rockway[(1)]

(1) SPAWAR SSC Pacific, San Diego, CA
(2) Long Wave Inc., Oklahoma City, OK
(3) George Mason University, Fairfax, VA
(4) University of Massachusetts at Boston, Boston, MA
(5) Independent, Reston, VA

There remains significant interest in understanding the spatial and temporal effects ionosphere disturbances have on radio wave propagation. In particular, RF propagation in the low frequency bands from 30 to 300 kHz is susceptible to ionospheric variations caused by volcanic and seismic activity as well as ionosolar eclipses. These variations modify the Earth-Ionosphere waveguide resulting in changes to the amplitude and phase difference along different transmission paths. The goal of this paper is to determine the feasibility of using an existing LF transmitter to support ionosphere-radio wave propagation studies in the future.

The U.S. Navy is contemplating the development of a beacon to support broadcast at a set of discrete frequencies across the low frequency band. The transmissions would involve day and nighttime CW broadcasts of short finite duration. A possible candidate for the research beacon is the LF site at NRTF Dixon. This site has a 615 foot tall Umbrella Top-Loaded Monopole (UTLM) and is set up to operate in the range from 30 to 150 kHz. The Navy used the site for surface ship communications at 135.9 kHz for decades but fell into disuse in the 1980's. The intent is to get the LF site to operational condition and to modify it to support different broadcast frequencies.

The proposed approach is to use the existing antenna and modify the tuning and matching elements to allow operation at frequencies of interest. The outcome of the study is to estimate the performance of the converted site as a function of radiated power versus selected frequency. The radiated power depends upon the efficiency of the antenna system, which is unknown in this frequency range, and is a function of several variables, including losses in the insulators, grounding system and tuning elements. A discussion will be first presented on the different antenna system resistances. Next, the selection of the individual tuning and matching elements will be presented to achieve the maximum radiated power at each frequency. Finally, once the radiated power is known for the different, discrete transmit frequencies, radio wave propagation calculations will be presented to determine overall coverage. An important outcome of this effort is to

solicit input from the attendees and others on how to improve the beacon to support radio wave propagation and ionosphere research experiments.