

Applicant is a staff member of the Woods Hole Oceanographic Institution.

The Woods Hole Oceanographic Institution is a US-based private, non-profit academic research institution focused on ocean science research and exploration. See www.whoi.edu for more information.

WHOI operates two types of HFR instrumentation as described by location here:

<u>System Location</u>	<u>System Hardware</u>
Provincetown, MA	CODAR SSTX-100
Salisbury, MA	CODAR SSTX-100
Chilmark, MA	CODAR SSTX-100
Marshfield, MA	CODAR SSTX-100
Gloucester, MA	CODAR SSTX-100
Nantucket, MA	University of Hawaii, MK-III
Narragansett, RI	University of Hawaii, MK-III
West Tisbury, MA	University of Hawaii, MK-III
Westport, MA	University of Hawaii, MK-III

The funding for CODAR-type system operation comes from NOAA IOOS. POC: Brian Zelenke (p: 240-676-6396).

The funding for the MK-III systems manufactured by the University of Hawaii, comes from the National Science Foundation. POC: Dana K. Savidge (p:703-292-4897)

For all CODAR-type systems:

The Woods Hole Oceanographic Institution operates and maintains a series of CODAR-type High Frequency Radar (HFR) stations as part of the Northeast Regional Coastal Ocean Observing system (NERACOOS).

NERACOOS is one of eleven regional associations funded by the NOAA IOOS program office to provide coastal oceanographic data for a variety of government and societal stakeholders. The nationwide HFR network of approximately 170 stations provides critical ocean surface current maps to NOAA and the United States Coast Guard (USCG) for planning search and rescue missions and spill response in addition to other maritime domain awareness purposes and users.

The systems described here are used both by USCG and NOAA as well as ocean science researchers for basic science understanding of the coastal ocean. The goal of this ELS

application is to transition existing stations to the ITU designated bands for oceanographic HFR as outlined in FCC order 17-33 (March 27, 2017).

The stations in this application have been operating under older NOAA ORFM frequency assignments but, as per the directive of the NOAA funding program (POC: Brian Zelenke) WHOI is applying for separate licenses for each site.

CODAR is currently pursuing equipment certification with its chosen Telecommunication certified Body (TCB), UL Verification Services, to allow users to apply for standard licenses via the ULS under Part 90, CODAR will be also working with Freedom Technologies, Inc. (FTI, a NOAA contractor). However, this will require CODAR and other regional operators to perform the following tests at existing HFR stations to prepare for the transition and aid in the national channeling plan being developed by FTI:

1. Identify the optimal ITU band at each station to continue to provide the best performance and to meet the needs of users of the surface current maps
 - Characterizing RFI environment within the ITU bands at each station
 - Measuring performance of existing equipment at each station for the appropriate bands
 - Once the proper frequencies are identified, each operator will need to determine if their equipment needs to be returned for retuning
2. At each station, waveform parameters need to be adjusted such as modulation multiplexing timing, sweep rates and pulse/gate timing in order to be synchronized with all other stations on the same band/channel to avoid interference
3. Determine the best channeling configuration that will work for all systems to operate simultaneously on the limited ITU bands
4. Determine proper timing of call sign station identification by the HFR station and ensure that it does not impact the data
- 5.

These tests must be performed incrementally and while still providing continuous measured ocean surface currents to NOAA and the United States Coast Guard (USCG) until such time as when all HFR systems are expected to be in compliance with FCC order 17-33.

For all University of Hawaii, MK-III systems

WHOI operates these systems on an experimental basis, working directly with the manufacturer to develop and refine HF radar methodologies and data products and applies them via research projects funded by the National Science Foundation.

Two of the existing stations operate at the proposed ITU 16.1-16.2 MHz bandwidth designated for HFR operations. These sites, Nantucket and Westport, were part of the existing permit that is being updated here.

Data from these systems are currently being used for research data collection on improving measurements of ocean surface winds directly from the HF radar returns.

A description of this research project, as submitted to the NSF, is below:

Wind is an important driver of the coastal ocean. Wind transfers energy to the ocean, which influences its movement, the growth of sea life, and our ability to predict them both. Changes in the surface winds have implications for fish stocks, search and rescue efforts, and offshore wind farms. However, present methods do not fully resolve near shore changes in winds. Today, a network of land-based radars measure ocean currents. We propose to use these radars to also measure winds. Measuring wind at the radar's space and time scales will capture its effect on the coastal ocean. The proposed research will expand on recent efforts to extract winds from radar data. We will measure winds with self-driving vessels near existing radars, for use as ground-truth. Ground-truth data will be used to refine models that extract wind from the radar data. These wind measurements will aid weather forecasts, and improve our understanding of the coastal ocean.

For the two new stations being applied for (Narragansett, RI and West Tisbury, MA), a separate but nearby frequency band is also requested (16.0-16.1 MHz). These frequencies will be used for a specific project with the University of Hawaii to develop, test, and apply GPS-based timing for the MK-III radars that will improve the abilities of the MK-III to operate multiple radars in closer proximity within the existing ITU 16.1-16.2 bandwidth in future research efforts.

This temporary expansion to a non-ITU band is required to ensure data collection for the NSF project described above can continue without interference while the GPS-based timing efforts are being performed. This additional research effort is expected to be concluded within the operational period of this permit application.