Care Weather Technologies
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August 6, 2020

Nimesh Sangani
FCC Office of Engineering and Technology
445 12th Street SW
Washington, DC 20554

SUBJECT: Hatchling Canary 1 pocketqube mission (FCC application #0997-EX-ST-2020).

Mr. Sangani:

Please find details on the Hatchling Canary 1 pocketqube mission included below.

Mission Licensing and Operations Timeframe

Date license is required[1]: December, 2020
LV integration date: December, 2020
Launch date: NET February, 2020.
Date for initiation of on-orbit operations: 1-5 days after launch.
Expected mission duration: 6 months

Points of Contact

Primary contact who can terminate ALL satellite and ground station transmissions.

Point of Contact Name:	Patrick Walton
Organization Name:	Care Weather Technologies
Role:	CEO, Mission Manager
Address:	144 W 400 N, Provo, UT 84601
Email:	patrick@careweather.com
Telephone Number:	(801) 227-4740

Secondary contact who can terminate ALL satellite and ground station transmissions.

Point of Contact Name:	Alex Laraway
Organization Name:	Care Weather Technologies
Role:	CTO, Principal Satellite Engineer
Email:	alex@careweather.com
Telephone Number:	(801) 636-3388

[1] Please do not reject the application if the license cannot be granted before the integration date. Care Weather's launch contract includes the option to move Hatchling Canary to the next launch if the license is not ready in December.

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Project Narrative, Concept of Operations, and Technical Description

Care Weather Technologies (Care Weather) is building the Hatchling Canary pocketqube satellite to demonstrate custom satellite computing, power, and radio communications electronics developed by Care Weather. Performance of these systems will be characterized through on-board instrumentation and transmitted to Care Weather's ground station in Provo, Utah over the radio link. In-space demonstration of these technologies supports Care Weather's mission of filling critical gaps in U.S. weather remote sensing capabilities by providing Care Weather with satellite bus technologies that can be tightly integrated with its wind-sensing radar.

Hatchling Canary is flying in the FOSSA Systems PicoBus deployer which will be integrated in the Momentus Vigoride transfer vehicle on the SpaceX Falcon 9. Momentus expects to release payloads shortly after it is released at the 450 km orbit, but they may boost to a 550 km orbit before releasing payloads. Upon release, Hatchling Canary's power system will be reconnected to its batteries by the separation switches. This will power the microcontroller system, which will initiate a timer. When the timer is completed, the microcontroller will initiate solar panel and antenna deployment using a nichrome and nylon burn wire system.

After deployment, the radio will begin listening for command, but not transmitting. When the satellite passes over the Care Weather ground station, the satellite will be commanded to downlink historical system data, which will be used to evaluate the performance of Care Weather's bus technologies on orbit. Hatchling Canary is equipped with delay transmit, stop transmit, and kill functions that enable Care Weather to temporarily suspend or permanently cease transmissions and place the satellite in a powered-off state. Its location in low orbits will allow the atmosphere to drag it down and burn it up for natural disposal.

Hatchling Canary has seven subsystems: power, command and computing, communications, structures, mechanisms, thermal control, and attitude determination and stabilization. The power subsystem includes four 5-fold deployable solar arrays, lithium-polymer batteries, and power management circuit boards. The command and computing subsystem includes a watchdog, a thermal timeout system, and a microcontroller. The communications subsystem includes an antenna and LoRa radio. The structure conforms to the 1p pocketqube standard and a printed circuit board is used as the base plate. Threaded rods and solderable brackets hold the board stack together and affix the body-mounted solar boards to the rest of the satellite. The mechanisms subsystem includes burn wire deployment subsystems that use nylon wires to restrain solar panels and the antenna in their stowed position. Nichrome wires heat and break the nylon wire, releasing the solar panels and the antenna. The attitude determination and stabilization subsystem includes an inertial measurement unit and six sun-sensing photodiodes for attitude determination and a permanent magnet for attitude stabilization.

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License Details

For the Hatchling Canary mission, Care Weather is requesting experimental special temporary authority for a 75 kHz satellite uplink at 459.0325 MHz and a 550 kHz satellite downlink at 468.775 MHz.

For the uplink band, we are requesting 459.0-459.075 MHz. This band is allocated for satellite uplink at Brigham Young University (BYU) for the Passive Inspection CubeSats mission. Brigham Young University is 1 mile away from Care Weather headquarters and their ground station has been authorized for a much higher transmit power than Care Weather is requesting (1.6kW vs. 10W). BYU has agreed to coordinate with Care Weather on shared, local use of this band, and a letter from BYU confirming this has been submitted to the FCC experimental licensing system.

For the downlink band, we are requesting operation between 468.45-469.0 MHz, which is part of a secondary allocation for the meteorological satellite service (space-to-EARTH) in the Federal Table and as such we expect coordination with NTIA is required. Hatchling Canary is a precursor to upcoming Care Weather satellites that will perform a meteorological mission with high impact for hurricane observation and forecasting. Hatchling provides important technology demonstration that lays the groundwork for these future meteorological satellite missions. Care Weather is aware of footnote US289 and will ensure that the Hatchling Canary power flux-density produced at the Earth's surface shall not exceed -152 dBW/m^2/4 kHz.

We are requesting the STA to facilitate timely authorization before integration into the launch vehicle. The six-month period of the STA is sufficient for on orbit demonstration of our bus systems.

This mission includes satellite bus systems only, so no earth observation is performed. A letter from NOAA has been provided to confirm this.

Additional Data for Applications Requesting Use of Federal or Shared Government Frequencies

Space Station Antenna

- Polarization: linear
- Orientation: aligned with magnetic field ± 20° (attitude stabilized using passive magnets)
- Dimension
    - Gain: 2.15 dBi

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- Beamwidth: 360° (half-wave dipole)

Earth Station Antenna

- Location: 40° 9’ 45” North, 111° 34’ 40” West, Springville, UT
- Polarization: Right-hand Circular
- Orientation: 360° rotation in azimuth, 90° rotation in elevation for satellite tracking
- Dimension
  - Gain: 10.8 dBi
  - Half-power Beamwidth: 42.6°
  - Elevation: 1457 m
  - Mounted on rooftop. Rooftop height above sea level: 1461 m
  - Top of antenna above sea level: 1462 m

Orbital Characteristics

- Inclination: 97° (10:15am LTAN Sun-synchronous)
- Apogee: 450±25 km to 550±25 km
- Perigee: 450±25 km to 550±25 km
- Period: 94 mins

Satellite System

Number of Satellites (Transmit and Receive): 1