

## STATEMENT OF RESEARCH PROJECT

### Question 6A. Description of the Nature of the Research Project Being Conducted

Through the Tyvak-0129 satellite, Tyvak validates the technologies needed to support the development of atmospheric sensors and methods for earth exploration satellite services (“EESS”). The program leverages the inherent relative low costs of CubeSat vehicle manufacture and launch capabilities to perform testing and demonstrations in real-world conditions, as well as flight training.

The satellites will adhere to a design specification co-developed by California State University, San Luis Obispo (“Cal Poly”) and Stanford University (“Stanford”) referred to as the CubeSat Standard.

Additional information regarding the CubeSat Standard can be found at the CubeSat Community website, <http://www.CubeSat.org/>.

The spacecraft will be fabricated, tested, launched, and operated by Tyvak using its Mission Operations Center (“MOC”) in Irvine, California, and using affiliated Earth stations in the Continental United States (CONUS) and internationally. T&C for the satellites will be carried out by Tyvak via a two-way link in the UHF band between 401-402 MHz. Additionally, there will be a payload communications capability that is separate from the T&C communications system to report data gathered on experimental operations. The payload communications system will downlink data from any test instruments to Tyvak-affiliated Earth stations using spectrum in the X-band between 8025-8400 MHz.

The Tyvak-0129 satellite has already been launched into orbit on 1/12/18 on a PSLV from Sriharikota, India. The satellite is anticipated to perform operations for approximately 2 years. The Tyvak-0129 satellite has been operating internationally under authority from the Norwegian Communications Authority (NKOM), but requests authority through the FCC for ground communication authority to the satellite through CONUS ground stations.

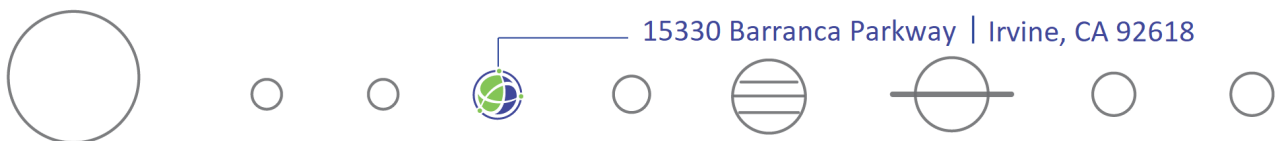
### Question 6B. Showing that the Communications Facilities Requested are Necessary for the Research Project

The primary purpose of Tyvak’s CubeSat program is to test and demonstrate new satellite capabilities or subsystems. On-orbit operation is the only effective way of collecting functional and performance data in the relevant operational environment and cannot be adequately substituted by ground testing or computer simulation.

With the proliferation of the CubeSat Standard and the availability of low-cost space access for those adhering to that standard, the cost to test miniature components on-orbit has become relatively inexpensive compared to equivalent ground testing and simulation. This is largely due to the availability of low-cost secondary payload launch options and cost sharing among multiple CubeSat developers.

In addition, on-orbit data provides confidence to customers that future systems will operate successfully on-orbit through maneuvers. The evaluation of hardware and software in an environment similar to that found in space is not easily replicated on Earth. On-orbit component failures are often attributed to unforeseen conditions or coupling of effects that cannot be tested adequately until on-orbit.

Consequently, the use of an on-orbit test bed provides significant direct and indirect financial benefits, as well as risk reduction for future satellite programs.



### Question 6C. Showing that Existing Communications Facilities are Inadequate

The ground stations that would be used for operations are established for T&C operations within the 401-402 MHz UHF band.

For the payload downlink, the 8025-8400 MHz X-band was chosen because many of the satellites will be testing Earth sensing hardware and downlinking Earth sensing data. This spectrum band contains an allocation for EESS operations and is thus appropriate for Tyvak's program.

