Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of:		
Streamlining Licensing Procedures for Small Satellites	)	IB Docket No. 18-86
Assessment and Collection of Regulatory Fees for Fiscal Year 2018	)	MD Docket No. 18-175

Comments of University Small-Satellite Researchers

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Summary

Academic researchers in the areas of aerospace engineering, space sciences, and other related fields agree: a streamlined licensing process for small satellites systems is needed to promote the continued deployment of innovative and low-cost small satellite systems in educational and scientific contexts. While CubeSat programs have allowed dozens of U.S. universities to produce invaluable scientific research and to graduate experts in space systems and mission operations over the past three decades, the current Part 25 application process is not suitable for educational small satellite systems. Accordingly, we generally support the Commission's effort to streamline the licensing process for small satellite programs.

However, we have significant reservations about the specifics of the proposed streamlined process. The proposed fee structure and operational characteristics, including altitude thresholds and propulsion requirements are likely to be prohibitive for typical educational and scientific small satellite missions. Accordingly, we urge the Commission to:

- Make clear that the streamlined process under Part 25 will stand as an alternative to, and not a replacement for, Part 5 and Part 97 paths that researchers currently rely on to deploy educational and scientific missions;
- Eliminate the proposed propulsion requirement altogether or reject the proposed altitude threshold for requiring propulsion in favor of allowing all missions with orbits that satisfy the ODAR 25-year requirement to deorbit passively, thereby ensuring that vital observation missions, including those that require polar orbits, are not effectively excluded from the streamlined process;
- Adopt a functional approach to trackability with a safe harbor for 1U and larger CubeSats;
- Allow the use of third-party casualty insurance for missions requiring non-ablating metals;
- Provide small satellite applicants regular feedback and clear explanations of any potential issues with their applications

- Make clear in implementing the *FY 2018 NPRM* that the non-profit exemption in 47 U.S.C. § 159(h)(1) and 47 C.F.R. § 1.1162(c) will apply to the streamlined Part 25 process or otherwise eliminate annual regulatory fees for educational applicants; and
- Lower the proposed application fee for educational users to no more than a modest increase over the $70.00 experimental licensing fee.

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Discussion

The above-listed academic researchers in the areas of aerospace engineering, space sciences, and other related fields respectfully comment on the Commission's Notice of Proposed Rulemaking to create a new regulatory category of small satellites under Part 25 of the Commission's rules (*Small Satellite NPRM*),[2] and reiterate our earlier comments[3] on the Commission's Notice of Proposed Rulemaking addressing the assessment and collection of regulatory fees for fiscal year 2018 (*FY 2018 NPRM*),[4] which includes a corresponding proposal to address the proposed annual regulatory fees for small satellite applicants.[5]

A streamlined licensing process for small satellites systems is needed to promote the continued deployment of innovative and low-cost small satellite systems, and the current Part 25 application process is not suitable for educational and scientific small satellite systems because of the high cost of the Commission's application and regulatory fees.[6] As the Commission explained in the *Small Satellite NPRM*, "obtaining a Part 25 regular commercial authorization for [a non-geostationary orbit (NGSO)] system can be challenging for some small satellite applicants because of the costs . . . involved, as compared to the overall scope of most small satellite enterprises," which, "[i]n some instances, . . . constitute a large percentage of the cost of the small satellite system, and could even exceed the total cost of a small satellite mission."[7]

While the changes proposed in the *Notice* are a step in the right direction, the level of the proposed fees, propulsion requirements, and lack of transparency could prevent university small

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[2] Streamlining Licensing Procedures for Small Satellites, Notice of Proposed Rulemaking, IB Docket No. 18-86 (Apr. 17, 2018) ("*Small Satellite NPRM*"), https://docs.fcc.gov/public/attachments/FCC-18-44A1.pdf .

[3] Comments of Dr. Scott Palo, et al., Docket No. 18-86 (June 22, 2018) ("*Researchers FY 2018 Comments*"), https://www.fcc.gov/ecfs/filing/1062172793709.

[4] Assessment and Collection of Regulatory Fees for Fiscal Year 2018, Report and Order and Notice of Proposed Rulemaking, MD Docket No. 18-175 (May 22, 2018) (*FY 2018 NPRM*), https://www.fcc.gov/document/fy-2018-regulatory-fees-nprm.

[5] *Id.* at ¶ 32.

[6] *Small Satellite NPRM* at ¶ 3.

[7] *Id.*

satellite programs from taking advantage of the streamlined application process. We urge the Commission to ensure that its final rules accommodate the participation of educational and scientific small satellite programs by removing or altering the propulsion requirement, constructing a transparent application process, and implementing a more reasonable fee structure for non-profit educational users.

I. The Commission should proceed with its overall proposal to adopt a streamlined process for small satellites.

As we noted in our comments on the *FY 2018 NPRM*,[8] we generally support the Commission's overall effort to streamline the licensing process for small satellite programs. These satellite systems are less than 180 kg in size, may take only months to develop, and are usually operational for a maximum of two years. Small satellites are becoming an increasingly popular alternative to traditional space satellites, and the number being launched is increasing annually.[9]

By acknowledging the fundamental differences between traditional and small satellites systems and taking the important step of proposing rules tailored to the needs of educational and scientific small satellite system operators, the Commission is fostering critically important innovation and research, stimulating the economic development of the small satellite industry and help maintain the U.S.'s leadership in technological innovation.

Universities and non-profit research institutes have been launching small satellite missions for more than three decades. Institutions like California Polytechnic State University–San Luis Obispo and Stanford University created the CubeSat standard and continue to drive innovation in small satellite system designs and operations. CubeSat programs have allowed dozens of U.S. universities to produce graduates with invaluable experiences in space systems development, integration and testing and space mission operations who have already contributed significantly to the U.S. space and defense workforce. The above-referenced researchers include principals at the following laboratories:

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[8] *Researchers FY 2018 Comments* at 2.

[9] *Small Satellite NPRM* at ¶ 7.

- The Colorado Center for Astrodynamics Research (CCAR) at the University of Colorado is dedicated to the study of astrodynamics and the application of satellites to science, navigation, and remote sensing of the Earth and planets.
- The Precision Space Systems Lab at the University of Florida relies heavily on nanosatellite missions to demonstrate new technologies for future space navigation, time transfer, communications and astrophysics observations.
- The Space Systems Group at the University of Florida conducts and facilitates research that addresses the technological challenges associated with the development of next generation high performance pico- and nano-class satellites for addressing socio-economic problems.
- The Space Systems Design Laboratory (SSDL) at Georgia Tech's Guggenheim School of Aerospace Engineering centers on identification and assessment of new technologies and approaches for robotic and human space and planetary exploration.
- The Space Telecommunications, Astronomy, and Radiation Laboratory at MIT develops technology demonstration payloads and novel nanosatellite system capabilities, with an emphasis on weather sensing, optical communications, and astrophysical applications.
- The Haystack Observatory is an interdisciplinary research center of the Massachusetts Institute of Technology (MIT) engaged in radio astronomy, geodesy, upper atmospheric physics, and radar applications. Its missions include study of the structure of our galaxy and the larger universe, advancement of scientific knowledge of our planet and its atmosphere, and advancement of technology and applications of radio science and radar sensing.
- The Michigan Exploration Laboratory develops small satellite explorers that push the state of the art is space technology and enable fundamentally new science endeavors. The Laboratory spearheaded the National Science Foundation's effort in small satellites and helped enable a new class of small, low-cost, highly relevant science missions. The Laboratory has trained next generations of space engineers that will continue to develop

humanity's space-based capabilities. Small satellites are integral to the Laboratory's research and training.

- The Space Science and Engineering Laboratory at Montana State University performs fundamental studies of the space environment, while engaging students in Space Physics research and in the design and development of small satellites with enhanced technical capabilities to further these research objectives.
- The Space Science Center at Morehead State University focuses on the development and operation of small satellites. The Center provides Telemetry, Tracking, Command (TT&C) services with the 21-meter Antenna LEO missions and TT&C and Ranging services for inner solar system interplanetary smallsat missions. The Center provides spacecraft environmental testing services including: vibration analysis, T-Vac, EMI/EMC, and antenna characterization.

However, the benefits of small satellite programs are increasingly limited by roadblocks of traditional RF frequency licensing paths. There are three paths available to non-government users to obtain a satellite frequency license.

First, Part 97 amateur licenses are increasingly unviable for many educational and scientific small satellite missions because the licenses must be used for the purpose of self-training and can have no pecuniary interest or financial benefit. Questions have arisen about the eligibility for Part 97 of professors building satellites as part of their academic research obligations or students who are being paid by a university as research assistants.

Second, Part 5 experimental licenses, while widely used in educational and scientific small satellite missions, carry significant risk and ambiguity because licensees must accept and cannot cause interference. Because of the Commission's interference policy for Part 5, transmitters must have the capability to turn off immediately, which can be difficult to implement given ground station availability and also jeopardize the viability of a mission. Moreover, the International Telecommunications Union (ITU) does not recognize experimental licenses for space operations, which has increasingly raised questions about the viability of educational and scientific small satellite missions with orbits above countries other than the United States.

Finally, the traditional part 25 satellite licensing path is impractical for small satellites. As the Commission explained in the *Small Satellite NPRM*, "obtaining a Part 25 regular commercial authorization for [a non-geostationary orbit (NGSO)] system can be challenging for some small satellite applicants because of the costs . . . involved, as compared to the overall scope of most small satellite enterprises," which, "[i]n some instances, . . . constitute a large percentage of the cost of the small satellite system, and could even exceed the total cost of a small satellite mission."[10]

Our comments on the *FY 2018 NPRM* explained that even sophisticated educational and scientific small satellite research projects ordinarily have access to budgets averaging approximately $300,000.[11] Thus, a $500,000 filing fee may represent double or more the entire budget of an educational or scientific mission, including the acquisition and assembly of the satellite's constituent parts, access to a launch vehicle, integration and testing, and mission operations. Moreover, the Commission's FCC's Part 25 application process can itself take up to seven years to complete. Small satellites, on the other hand, can be developed and launched in as little time as 1 year, and some nanosatellites cost only a fraction of traditional satellites, from $50,000 to $250,000, compared to traditional satellites with build costs ranging from $30 million up to $3 billion.

In short: the Commission's traditional Part 25 licensing system simply takes too long and is too expensive for current developers and operators. For example:

- The University of Colorado Challenger CubeSat is part of the international QB50 program and was designed provide measurements of the near-earth space environment. This 2U cubesat was built for less than $230,000 and has been operating on orbit since May 2017. The launch costs were supported by the NASA CubeSat Launch Initiative program.

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[10] *Id.* at ¶ 3.
[11] *Researchers FY 2018 Comments* at 4.

- The MIT Nanosatellite Optical Downlink Terminal payload has cost less than $250,000 including hardware and graduate student research time. A 3U nanosatellite bus for NODE would cost an additional $200,000, and the launch opportunity would be supported by the NASA CubeSat Launch Initiative program.
- The University of Texas at Austin's Formation Autonomy Spacecraft with Thrust, Relnav, Attitude, and Crosslink (FASTRAC) was a two-vehicle small satellite project (<60 kg total mass) that was designed, built, launched, and operated for two years for less than $250,000. Costs were primarily hardware using student volunteers. The launch was provided by the DOD Space Test Program and occurred on STP-S26 in November 19, 2010.
- National Science Foundation projects are funded at approximately $900,000 to perform fundamental space weather research, sometimes over multiple missions, and typically operate for several years. For example, Montana State University's Focused Investigations of Relativistic Electron Burst Intensity, Range, and Dynamics (FIREBIRD-II) mission consisting of two 1.5U CubeSats has been in operation for more than 40-months returning unique measurements of the loss into the upper atmosphere of electrons from the Van Allen Radiation Belts.

II. The Commission should clarify that the streamlined Part 25 approach for small satellites is an alternative path to and not a replacement for Part 97 and Part 5 licensing.

While Part 25 licenses have benefits over Part 97 and Part 5 licenses—in particular, interference protection and no need for amateur coordination—the Commission needs to clarify the proposed streamlined process under Part 25 will not become the sole path available to university researchers. Even the lower application and regulatory fees proposed in the *Small Satellite NPRM* will pose a barrier for entry for educational and scientific small satellite missions. If the streamlined Part 25 approach becomes the only path for small satellites, it will effectively prevent university small satellite research and innovation, particularly for new schools with fewer resources to fly small satellite missions, if it is not properly calibrated to facilitate the types of missions currently served by Part 97 and Part 5.

While we are hopeful that the Commission will modify the streamlined process as we suggest[12] to make it a viable option for the university small satellite community, the proposed streamlined process does not guarantee that this will materialize. As a result, we urge the Commission to make clear that the streamlined process under Part 25 will stand as an alternative to, and not a replacement for, the traditional paths that researchers have pursued under Part 5 and Part 97. More specifically, the Commission should commit to continuing to evaluate university Part 5 and Part 97 applicants on the terms it does now notwithstanding the availability of the streamlined Part 25 process.

III. The Commission should reconsider some proposed characteristics of satellites and systems that qualify for streamlined processing. (¶¶ 25-40)

The *Small Satellite NPRM* sets forth various criteria that would allow small satellite systems to qualify for streamlined processing.[13] The Commission notes that narrow eligibility requirements will facilitate faster review of satellite applications, which will in turn encourage the development and launch of new research and Earth observation systems.[14]

Many of the criteria, such as number, lifetime, and size will help ensure that only small satellite systems can take advantage of streamlined processing and the new framework will not become overcrowded, abusive, or a replacement for the Commission's traditional Part 25 licensing process. However, some criteria—in particular, the propulsion requirement—need to be changed to ensure that the Commission's new satellite licensing framework reflect the type of small satellite systems that the Commission seeks to encourage.[15]

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[12] *See* discussion *infra*, Parts III-VI.

[13] *Small Satellite NPRM* at ¶¶ 21, 25.

[14] *Id.* at ¶ 25.

[15] *See generally* NASA, Small Spacecraft Technology State of the Art (Dec. 2015), https://www.nasa.gov/sites/default/files/atoms/files/small_spacecraft_technology_state_of_the_art_2015_tagged.pdf

A. The Commission should proceed with its requirements to limit number of spacecraft, planned on-orbit lifetime, and maximum spacecraft size. (¶¶ 27, 28, 29, 32).

The Commission proposes in the *Small Satellite NPRM* to limit the number of spacecraft deployed under the streamlined process to ten satellites per license.[16] We agree with the Commission's assessment that university small satellite operators usually intend to launch at most a few satellites in the context of a license for a given mission,[17] though **the Commission should make clear that the limit of ten satellites per license applies only per orbital plane if it chooses to append applications for different orbital planes for different missions to same parent license for a single licensee.** Limiting the number of spacecraft allowed to be deployed under this proposed process will further the goal of faster review. An explicit goal of the proposed streamlined process is to make it easier for small satellites to continue advancing scientific research.[18] Protecting the proposed streamlined process from becoming overcrowded will helpfully avoid putting a strain on application review and a tension on spectrum use.

The Commission also suggests that total on-orbit lifetime be planned to be a maximum of five years, which will correspond with the license term.[19] Restricting license terms to five years will help prevent congestion and fits well with the mission profiles of educational and scientific small satellite systems, as most average two years from launch to decommissioning. **However, we encourage the Commission to clarify that the five-year license term encompasses only *on-orbit* lifetime** and does not include the period of non-transmitting orbital decay, which for many scientific missions will approach the ODAR 25-year rule limit notwithstanding the short transmission lifetime.

Additionally, the Commission proposes in the *Small Satellite NPRM* to limit applications to spacecraft with a maximum mass of 180 kg.[20] We agree with the Commission's assessment that

[16] *Small Satellite NPRM* at ¶ 27.
[17] *Id.*
[18] *Id.* at ¶ 1.
[19] *Id.* at ¶ 29.
[20] *Id.* at ¶ 32.

following NASA's demarcation of the small satellite category should be enough to allow most small satellites to have access to the streamlined process.[21] Similar to the other characteristic restrictions, it is crucial the scope of eligible spacecraft remain tailored to small satellites so the application system does not become overwhelmed. The goal of quicker application reviews would be negated if the system becomes overcrowded.

B. The Commission should eliminate the propulsion requirement or increase the deployment height. (¶¶ 33-35)

The Commission's proposed rules would require that applicants certify their compliance with certain deployment and maneuverability restraints.[22] Specifically, the proposed rules would require an operator deploying above the height of the International Space Station (ISS) at 400 km to have propulsion capabilities to be eligible for the streamlined process.[23]

We urge the Commission to reject this requirement by eliminating the propulsion requirement altogether, or at a bare minimum, to reject a specific altitude threshold for requiring propulsion in favor of allowing missions with orbits that would otherwise exceed the ODAR 25-year requirement to deorbit passively. While we understand that the altitude was chosen as an attempt to mitigate collision risk, this requirement would introduce unwanted consequences for researchers attempting to take advantage of the streamlined process. The restriction of deploying at the ISS height of 400 km is not workable because it severely limits the potential orbits, lifetime, and uses of the small satellite.

A deployment height of 400 km limits the orbital plane a small satellite can use and precludes polar orbits, which are of keen scientific interest for Earth and space weather observation. The deployment height restricts the orbital plane because there are no launch vehicles that go to

[21] *Id.*
[22] *Id.* at ¶ 33.
[23] *Id.*

inclinations other than 51.6 degrees at 400 km.[24] An altitude of 500 km or more is generally required to obtain a polar orbit.

Moreover, at the proposed altitude in mild solar conditions, a small satellite will generally have less than a year before deorbiting. This reality would severely undercut the proposed five-year license term. According to NASA, only orbits beyond 600 km become problematic for natural orbital decay within a reasonable amount of time.[25] And even eccentric-orbit-satellites with an apogee greater than 600 km and low enough perigee can still passively satisfy the ODAR 25-year limit.

Although *Small Satellite NPRM* does not per se preclude deployments above 400 km, it proposes to require small satellites under the streamlined Part 25 process deployed above 400 km to incorporate propulsion capability. While deploying below 400 km is not realistic, propulsion requirements are also unfeasible for many small satellite systems because they add significant additional cost and system complexity.

Very few small satellites are currently deployed with active propulsion. The Commission concedes that current systems do not use propulsion but claims there is new technology that will ease the transition to including active propulsion systems.[26] While technology is developing, it is not yet at the level needed to facilitate easy or affordable implementation in typical missions, and requiring it would essentially bar university programs from small satellite participation.

More specifically, many propulsion systems require 1U or more of volume, cost from $50,000 up to $200,000 or more, take up valuable onboard resources including power, and affect the thermal profile of small satellites. Active propulsion systems may also introduce additional risks and range safety considerations. In essence, requiring propulsion would make many educational and scientific small satellite missions impossible. Existing passive deorbiting systems that increase the satellite's

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[24] *See generally* SPACEFLIGHT, Launch Schedule, Getting to Space doesn't have to be complicated, http://spaceflight.com/schedule-pricing/#schedule (listing upcoming launches that accommodate cubesats) (last visited July 9, 2018).
[25] NASA, Passive Deorbit Systems, State of the Art of Small Spacecraft Technology, https://sst-soa.arc.nasa.gov/12-passive-deorbit-systems.
[26] *Small Satellite NPRM* at ¶ 34.

drag take up less space and could fulfill the same purpose of limiting orbital lifetime while reducing the risks presented by propellants.[27]

Moreover, a propulsion requirement could disrupt the operations of the Joint Space Operations Center (JSpOC), which uses prior information on the position of satellites to corroborate their identities with tracked objects. This works relatively well because the position of a satellite is relatively deterministic and controlled by Kepler's physics. If small satellites had propulsion and were constantly moving around, JSpOC's current tracking model would break because it would have no way to associate the objects with identifiable satellites.

At a bare minimum, an orbit of up to 600 km with a natural deorbit of 4 to 7 years would be much closer to the Commission's 5-year license term goal.[28] However, we urge the Commission to reject a specific altitude threshold for requiring propulsion in favor of allowing all missions with orbits that satisfy the ODAR 25-year requirement to deorbit passively.

C. The Commission should adopt a more flexible and functional approach to trackability. (¶ 38)

We share the Commission's concerns about the importance of small satellite trackability.[29] However, the Commission's proposal to require a qualifying satellite to "include a unique telemetry marker allowing it to be readily distinguished from other satellites or space objects" is underspecified and unclear.[30] Conversely, the Commission's proposal to require that applicants certify that their satellites will be no smaller than 10 cm x 10 cm x 10 cm is overly specific and risks precluding innovative, low-cost designs such as Virginia Space's ThinSat or the Aerospace Corporation's 0.5 U

[27] NASA, Passive Deorbit Systems, State of the Art of Small Spacecraft Technology, https://sst-soa.arc.nasa.gov/12-passive-deorbit-systems.
[28] NASA: Tracking CubeSats is easy, but many stay in orbit too long https://spaceflightnow.com/2015/07/30/nasa-tracking-cubesats-is-easy-but-many-stay-in-orbit-too-long/.
[29] *See Small Satelliete NPRM* at ¶ 38.
[30] *See id.*

CubeSats that may be sufficiently trackable but smaller than the 1U size of a CubeSat.[31] Rather than dictating specific design parameters, we recommend that the Commission adopt a functional requirement that small satellites be trackable, setting a safe harbor for satellites 10 cm x 10 cm x 10 cm or larger and allowing applicants to make a showing that smaller satellites are trackable.

D. The Commission should allow for third-party insurance for scientific missions involving metals that do not ablate upon reentry. (¶ 39)

The Commission proposes to require applicants to certify "that any small satellite applicant seeking to file under the streamlined process certify that it has conducted a casualty risk assessment using the NASA Debris Assessment Software (DAS)129 or another higher fidelity model, and that the assessment resulted in a human casualty risk of zero."[32] While we generally agree that this requirement is appropriate for applicants under the streamlined process, we note that some scientific missions involve small quantities of metal that melt at high temperatures and do not ablate upon reentry. We urge the Commission to allow case-by-case exemptions for researchers using such metals out of necessity to demonstrate that they can mitigate any potential casualty risk through the carriage of third-party insurance.[33]

IV. The Commission should proceed with removing small satellites authorized under the streamlined process from processing round procedures but improve transparency. (¶¶ 41-53)

The Commission proposes to exclude small satellites authorized under the streamlined process from processing round procedures. We agree with the Commission's assessment that spectrum demands of such systems differ considerably from NGSO-like systems that require full-time

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[31] *See id.*; Virginia Space, ThinSat Program, http://www.vaspace.org/index.php/thinsat-program (last visited July 4, 2018); The Aerospace Corporation, The Aerospace Nano/PicoSatellite Program at 15, https://www.nasa.gov/sites/default/files/files/D_Hinkley-Aerospace_PICOSAT_Capability_Status_2014.pdf.
[32] *Small Satellite NPRM* at ¶ 39 (internal citations omitted).
[33] Many state universities will not tolerate the risk of casualty, so we expect that usage of case-by-case exemptions would be limited.

availability. Changing the requirement to certifications and brief narrative description could considerably speed up the application process and reduce the burden on small satellite programs.

A. The Commission should implement more transparent application progress tracking. (¶¶ 41-46)

The Commission also seeks to reduce the extensive application processing period that follows a Part 25 license application by skipping the traditional application processing round.[34] However, transparency must still be improved. Small satellite applicants need regular feedback and clear explanations of any potential issues with their applications.

As the Commission acknowledges, small satellite operators usually do not have their own launch vehicles and must often share rides with other satellite operators.[35] Small satellites must be integrated with the launch vehicle well ahead of license approval. If the FCC's process is not sufficiently transparent, a satellite operator might integrate their satellite before license approval, assuming that license approval will be forthcoming at the FCC. If the license is not approved in a timely manner, the satellite would be left without a license to operate upon launch. The launch vehicle provider will not release the small satellite, causing the satellite to be lost. More transparent application tracking will enable small satellite operators, who are often not familiar with the FCC's processes, to submit their own license applications and successfully navigate launch processes.

B. The Commission should continue to reduce the required paperwork in order to alleviate the regulatory burden on small satellite operators and reflect the short duration and low impact nature of small satellite systems. (¶¶ 47-48)

The Commission proposes to decrease the application form requirements in order to ease the application burden of small satellite operators.[36] While FCC Form 312 and Schedule S will still be required,[37] the reduction of the required narrative description to certification and how an applicant's operation will not preclude future operators from using the same band should ease the burden on

[34] *Id.* at ¶ 43.
[35] *Id.* at ¶ 5.
[36] *Id.* at ¶ 48.
[37] *Id.* at ¶¶ 47, 48.

applicants. A decrease in filing requirements is a welcome change that will reduce the burden on university researchers submitting applications. It is a step in the right direction that reflects the low impact nature of small satellite systems.

C. The Commission should grant small satellite operators a one-year grace period from posting a surety bond. (¶¶ 49-53)

Currently, a satellite operator is required to post a surety bond (up to $5 million) within 30 days of receiving a license.[38] The surety bond is lost if the license grantee fails to reach landmark criteria or fails to comply with operational requirements. The main goal of the surety bond is to ensure operators are not squatting on a license. If the satellite system hits its milestones, the licensee is alleviated of the bond requirement.[39]

The Commission proposes that small satellite operators be granted a one-year grace period from posting a surety bond. The grace period would begin 30 days after the license is granted.[40] The Commission reasons that because of the short time frame between filing the application and deployment, the upfront surety bond is not necessary. [41]

We agree that because of the short window, short operational lifespan, and sharing requirements, there is little incentive or ability for small satellite operators to squat on licenses. In addition, as the Commission notes, because the license term is only five years and is non-renewable, the use of resources will not be inhibited.[42]

If an operator does not launch within one year of the license being granted, they must either post a surety bond or surrender their license in order to avoid posting a surety bond.[43] This is reasonable because launch delays can exceed a year or more and an operator should have the option

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[38] *Id.* at ¶ 49.
[39] *Id.*
[40] *Id.* at ¶ 50.
[41] *Id.* at ¶ 51.
[42] *Id.* at ¶ 51.
[43] *Id.* at ¶¶ 52, 53.

of keeping the applied-for license and posting a surety bond or surrendering the license and reapplying.

V. The Commission should proceed with its technical rules and frequency considerations while ensuring access to frequencies on a non-interference basis. (¶¶ 54–73)

The Commissions suggests applying Part 25 technical rules to the streamlined process. Avoiding interference with other stations is a significant concern, and we agree that Part 25 technical rules such as limits on out-of-band emissions and power limits should apply to small satellites authorized under the streamlined process in the same way.

We also agree with the Commission's proposed rule changes to the frequency considerations for small satellites. As some experimental small satellites rely on amateur frequencies for their communications, these changes would offer a promising starting point for small satellite research. While spectrum sharing is a promising approach to further reduce the application processing time, it is important to ensure that the bands small satellites will operate on are shared on a non-interfering basis and that small satellites are protected from interference.

VI. The Commission should implement fees that consider small entities and are reflective of the nature of small satellites. (¶¶ 74–77)

The Commission has proposed in the *Small Satellite NPRM* to lower the application fees for small satellite applicants qualifying for the streamlined Part 25 procedure from Part 25's current $474,705 fee to $30,000,[44] and in the *FY 2018 NPRM* to lower the annual regulatory fee to 1/20th of the current $135,350 fee, or $6,767.50.[45]

As we explained in our comments on the *FY 2018 NPRM*, which we incorporate by reference here,[46] the Commission should holistically consider the aggregate impact of the fees on small satellite missions. In particular, the educational and scientific small satellite missions that most educational institutions are interested in pursuing generally last no longer than two years. Thus, the

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[44] *Id.* at ¶¶ 75-76.

[45] *FY 2018 NPRM* at ¶ 32. We agree with the Commission's conclusion that adopting a new regulatory category for small satellites would be permissible. *See id.* at ¶ 33.

[46] *See generally Researchers FY 2018 Comments*.

aggregate of the application fee and two years of the ongoing regulatory fees to receive a license for such a mission could run as high as $43,535.00 ($30,000.00 up-front and an additional $6767.50 during each year of operation)—more than 15% of the average $300,000 budget of a relatively sophisticated educational or scientific small satellite mission and a more than 600-fold increase over the fee for a comparable Part 5 experimental license.

Accordingly, we again urge the Commission:

- At a bare minimum, to make it clear in implementing the *FY 2018 NPRM* that the non-profit exemption in 47 U.S.C. § 159(h)(1) and 47 C.F.R. § 1.1162(c) will apply to the streamlined Part 25 process,[47] or otherwise eliminate the annual regulatory fees for educational applicants, consistent with the Part 5 fee structure and the letter and spirit of Section 159(h)(1);[48] and
- To substantially lower the streamlined Part 25 application fee for educational and scientific users to be in line with the $70.00 experimental licensing fee, with no more than a modest increase to reflect the additional processing and interference protection benefits.[49]

Respectfully submitted,
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[47] *See id.* at 4-5.
[48] *See id.*
[49] *See id.* at 5.