SECURE WORLD FOUNDATION

Promoting Cooperative Solutions for Space Sustainability

525 Zang Street, Suite D
Broomfield, CO 80021 USA
tel +1.303.554.1560
fax +1.303.554.1562
www.swfound.org

Dialogue on Practices for CubeSat Post Mission Disposal
Summary of Key Themes

August 10, 2017 • 2017 SmallSat Conference • Logan, Utah

Dialogue Introduction

As the use of cubesats becomes increasingly common in commercial, scientific, and academic missions – and as the number of these satellites launched continues to increase – there has been significant discussion in the space community on how cubesats relate to the challenge of space debris. An aspect of this discussion includes best practices for post mission disposal (PMD) of cubesats. To explore these issues, SWF convened a side event at the 2017 Small Satellite Conference in Logan, Utah, to discuss appropriate PMD practices for commercial space operators, and on actions for increasing confidence in, and understanding of, those practices. The Dialogue on Practices for CubeSat Post Mission Disposal took the form of a moderated small group discussion with satellite operators (including commercial and academic), satellite manufacturers, and de-orbit and launch service providers.

This workshop was held under Chatham House Rule and was not for attribution. This document summarizes the key discussion themes and questions raised by the workshop. The views expressed in this summary report do not necessarily reflect those of Secure World Foundation, the individuals in attendance, or their respective institutions, organizations, or governments.

Key Discussion Themes

During the conversation, several key themes emerged:

1. Communicating Compliance with Post-Mission Disposal Guideline

   The Dialogue began with a discussion of data on spacecraft compliance rates with the international guideline for de-orbit or disposal within 25 years of the end of mission. Data compiled by the European Space Agency (ESA) shows that approximately 60% of LEO spacecraft comply with the 25-year guideline.[1] However, participants in the Dialogue noted that compliance within the cubesat class is better than compliance for larger satellites.

   Participants noted that there is a disconnect between the actual rate of cubesat compliance with the 25-year guideline and the perception that cubesats are a disproportionate contributor to an increased space debris population, due in part to the dramatic increase in the number of cubesats being launched in recent years. Participants expressed a need to restate the issue: the question is not how many cubesats are flying, but rather how many of them are not compliant with the guideline. It was noted that the community needs to show and communicate that they are

[1] European Space Agency. "ESA's Annual Space Environment Report," April 27, 2017, https://www.sdo.esoc.esa.int/environment_report/Environment_Report_I1R2_20170427.pdf

525 Zang Street, Suite D
Broomfield, CO 80021 USA
tel +1.303.554.1560
fax +1.303.554.1562
www.swfound.org

complying; and on the flipside, communicate which satellites are not compliant and why. For cubesats that are not compliant, several participants felt it would be important to ascertain and communicate the reasons why compliance was not achieved in order to develop corrective practices.

It was noted that most cubesat missions currently fly in orbits which naturally decay within the 25-year period. Most of the non-compliant cubesats were launched early on when the only rides available were to higher orbits. Some participants noted that most academic (university and high school) operators do not desire their systems to operate on orbit more than a few semesters – otherwise the administrative burdens of operating the spacecraft outweigh the educational benefit (as the involved students move on). Some participants expressed the belief that commercial operators will feel more pressure to push the envelope on spacecraft lifetime than will academic and government operators.

2. Development of De-orbit Assist Devices

The conversation then turned to the possible role of active and/or passive de-orbit assist devices as cubesat operators begin to operate in higher orbits that do not naturally decay within the 25-year period. It was noted that several technology solutions that might be used to de-orbit a small satellite at the end of mission or following an on-orbit failure are being developed and tested, including propulsion modules and drag devices.

Discussion on this topic focused on reliability. As operators add de-orbit devices to their spacecraft so they can operate in higher orbits, does reliance on the device lead to a risk of non-compliance with PMD due to failure of the de-orbit device itself? The need to, and challenges of, proving reliability of de-orbit devices prior to fielding was raised by some participants. The reliability of other on-board systems on the spacecraft was also discussed. Several participants questioned whether the on-board avionics systems used on cubesats are robust enough to enable effective use of de-orbit devices. If cubesats are operating in higher orbits and for longer lifetimes, will the avionics last long enough to function when it is time to de-orbit? Some participants also noted that on-board propulsion with a cubesat is particularly challenging as it requires a much higher level of reliability and expertise that is common with most cubesat operators today.

Participants also noted a tension in current policy and practice concerning spacecraft systems which might be used for de-orbit assist. The current licensing processes and PMD guidelines favor propulsive solutions; while the launch operators providing the rideshare solutions which are commonly used by cubesat and smallsat operators, often discourage propulsive systems (due to risks to the primary payload). Regardless of these issues, many Dialogue participants felt that de-orbit devices are likely more appropriate or useful for the class(es) of satellites larger than cubesats – for example the spacecraft being developed to enable the planned large LEO constellations for broadband communications.

525 Zang Street, Suite D
Broomfield, CO 80021 USA
tel +1.303.554.1560
fax +1.303.554.1562
www.swfound.org

3. A Broader Meaning to Post Mission Disposal

   A final theme of conversation at the Dialogue focused on a need to broaden the conversation around of end of mission best practices and PMD beyond just de-orbiting. Participants expressed a need for the operator community to develop a better shared understanding over how "end of mission" or "end of spacecraft life" is defined. This might include developing best practices for end of life spacecraft passivation and configuration for end of mission, covering topics such as: battery discharge, shutting down transmit functions, and safing of other spacecraft systems. Some participants noted that ESA has been working on this topic through the CleanSpace program.

Next Steps and Further Work

Participants identified several areas or actions through which the topics discussed at the Dialogue might be further developed or addressed within the space community. These include:

- Increasing communication on cubesat PMD guideline compliance at industry events, and increasing interaction with space debris modeling and tracking community to better understand where there is non-compliance.
- Working to build better information sharing links with the policy and regulatory community.
- Leveraging cubesat developer and operator community events to begin to build dialogue on best practices for end of life operations, beyond the de-orbit guidelines.

For its part, Secure World Foundation views this Dialogue as part of a series of conversations we plan to convene around the topic of norms of behavior in space. The themes and questions raised during this discussion will be revisited and further explored in subsequent events**.**