

The US Air Force compliance with the Orbital Debris Mitigation Standard Practices

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ABSTRACT

The US Government Orbital Debris Mitigation Standard Practices (ODMSP) are a set of technical guidelines established to provide guidance on the mitigation of debris generation during normal operations and accidental explosions, on the avoidance of on-orbit collision, and on post-mission disposal. Based on previous NASA guidelines, they were adopted in 2001 and revised in late 2019 with the addition of a fifth part with considerations on large constellations, proximity operations, on-orbit servicing, etc. They serve as the principal debris-related requirements of space activities subjected to the supervision and control of the US government as explicitly required in the National Space Policy of 28 June 2010. The latter however authorizes the approval of “exceptions” to the ODMSP by the head of the agency sponsoring the space activities. In the case of the US Air Force, waivers should be requested by the Secretary of the Air Force to the Secretary of Defense. By delegation, the Deputy Secretary of Defense then evaluates the proposal and decides whether to grant the waiver or not. Any approval should be notified to the Secretary of State. This paper investigates the attribution of waivers to the US Air Force during the last decade. In other words: since the enactment of the National Space Policy of 2010, what was the degree of compliance of the US Air Force with the ODMSP?

To answer this question, this paper draws from two sources of data. Firstly, a clear objective response is provided by a successful Freedom of Information Act (FOIA) request on the number of “national security space launches” realized by the Air Force from 2011 to 2018 and their compliance with the ODMSP, published for the first time in this paper. Secondly, to understand the hidden dynamics of the evolution of the Air Force’s compliance with the ODMSP, the author interviewed numerous experts familiar to the matter, mostly current officials at the Department of Defense and the Department of State. They helped provide an explanatory framework behind the FOIA’s dry answer, in particular regarding project development cycles at the Department of Defense and the personal influence of key decision-makers.

The paper is organized as follows. After providing details on the historical developments having led to the drafting of the ODMSP and further explanations of the requirements established by the National Space Policy of 2010, it reviews the implementation of these requirements into the Department of Defense’s and the Air Force’s own directives and (policy) instructions. Then, the core of the paper presents the recent drive of the Air Force towards compliance with the ODMSP. It analyzes various reasons having led to this improvement of the Air Force’s behavior with a specific focus on the actual evolution of its launch capabilities and the personal push of a Deputy Secretary of Defense for increased compliance. Elements of comparison are provided with a quick factual presentation of NASA activities’ compliance with the ODMSP. Finally, the last section comments on the interagency discussions for the revision of the ODMSP, which conclusions were announced in December 2019. It investigates the push of representatives of the Department of Defense for a shorter post-mission disposal deadline, defeated by NASA’s winning position to stick with the 25-year rule.

1. INTRODUCTION

The US Government Orbital Debris Mitigation Standard Practices (ODMSP) are a set of technical guidelines established to provide guidance on the mitigation of debris generation and serving as the principal debris-related requirements of space activities subjected to the supervision and control of the US government as explicitly required in the National Space Policy of 28 June 2010. Main actor of space utilisation in the US government, the Department of Defense (DoD), composed of all the military departments as well as the National Reconnaissance Office (NRO), is, as any other operator in the US, subjected to the ODMSP. The 2010 Space Policy however authorizes the approval

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of “exceptions” to the ODMSP by the head of the agency sponsoring the space activities. In the case of the US military, waivers should be requested to the Secretary of Defense. By delegation, the Deputy Secretary of Defense then evaluates the proposal and decides whether to grant the waiver or not. Any approval should be notified to the Secretary of State. Building upon the great work initiated by Stephen Garber [1], this paper investigates the posture of the US military on space debris mitigation with a focus on the attribution of waivers to the US Air Force (USAF) during the last decade.

To do so, the analysis draws from two sources of data. Firstly, a clear objective response is provided by a successful Freedom of Information Act (FOIA) request on the number of “national security space launches” realised by the Air Force from 2011 to 2018 and their compliance with the ODMSP. Secondly, to understand the hidden dynamics of the evolution of the Air Force’s compliance with the ODMSP, the author interviewed numerous experts familiar to the matter, mostly current officials at the Department of Defense and the Department of State. They helped providing an explanatory framework behind the FOIA’s dry answer, in particular regarding project development cycles at the Department of Defense and the personal influence of key decision-makers.

The paper is organized as follows. After presenting the methodology and data used for the study, it provides the historical background of the ODMSP and the National Space Policy of 2010 and reviews the implementation of these requirements into the DoD’s and the Air Force’s own directives and instructions. Then, the paper presents the recent drive of the Air Force towards compliance with the ODMSP. It analyses various reasons having led to the improvement of the Air Force’s behaviour in outer space with a specific focus on the actual evolution of its launch capabilities and the personal push of key decision-makers for increased compliance. Finally, it also comments on the interagency discussions for the revision of the ODMSP, which conclusions were announced in December 2019, and that were the subject of intense speculation regarding the respective inputs of the main participants.

2. METHODOLOGY

This methodology of this study is quite simple and centred on the analysis of the intersections among three areas, as shown of figure 4-1:

1. **Regulations**, corresponding to the body of rules applicable to the DoD with regards to space debris mitigation, and their implementation in the DoD’s own internal requirements.
2. **Perception**, meaning the understanding or awareness of the DoD personnel on the importance of debris mitigation and their commitment to enhancing DoD practices.
3. **Implementation**, that is to say analysing the actual implementation of debris mitigation regulations to DoD activities in outer space, in other words the level of compliance of DoD activities with the ODMSP.

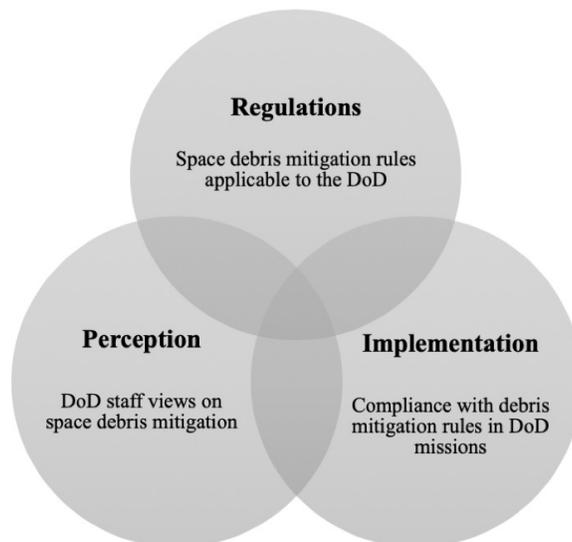


Fig. 1. Three areas of investigation and intersections

3. DATA

This paper draws from two sources of data: interviews, to understand the hidden dynamics at stake in the DoD with regards to space debris mitigation and a successful FOIA request to provide an objective measurement of the Air Force’s compliance with the ODMSP.

3.1. Anonymous interviews

Most of the information related to military behaviour in space and approach to space sustainability being undisclosed publicly – though not necessarily classified, studies need to rely primarily on anonymous interviews with direct stakeholders. They help to understand the views of DoD personnel on the mitigation of space debris, the potentially conflicting organisational approaches within the DoD (e.g. between the OSD, the USAF and the NRO), and the role played by influential decision-makers.

3.2. Freedom of Information Act requests

In this paper, FOIA requests were made with the goal of providing clear objective data to confirm or infirm the information obtained during anonymous interviews. Three requests were made for this study, as summarised in table 1:

- **Request 2019-00979-F**, the only successfully completed one, focussed on the number of waivers granted by the Secretary of Defense to USAF launches from 2011 to 2018.
- **Request 19-F-1762**, still processing, went a step further than the previous one by requesting a copy of the actual waiver signed by the Deputy Secretary of Defense and of all supported documents submitted to him to support his decision.
- **Request F-2019-00117**, still processing, is the same as the previous one but focussing specifically on waivers granted to the NRO.

Table 1. FOIA requests submitted for this study

FOIA reference	Submitted to	Submission date	Status (date)
2019-00979-F	Air Force Headquarters	30 November 2018	Completed (final response: 16 October 2019)
19-F-1762	Office of the Secretary of Defense/Joint Staff FOIA Requester Service Center	28 August 2019	Processing (interim response: 6 September 2019)
F-2019-00117	Information Review and Release Group, National Reconnaissance Office	9 September 2019	Processing (interim response: 12 September 2019)

4. ORBITAL DEBRIS MITIGATION RULES APPLICABLE TO THE US MILITARY

The US military, as any other agency of the federal government, is subjected to specific rules with regards to space debris mitigation. This section introduces applicable regulations and their implementation into the DoD’s and the USAF’s own sets of internal requirements.

4.1. The US Government Orbital Debris Mitigation Standard Practices

The USG ODMSP are a set of technical guidelines established to provide guidance on the mitigation of debris generation, adopted in 2001 on the model of previous NASA guidelines. At the time of their adoption, they comported eight requirements divided into four categories [2]:

1. “Control of debris released during normal operations”. It concerns design measures to limit the emission of debris from spacecraft and rocket bodies, and in particular of those larger than 5 mm and susceptible to stay in orbit more than 25 years (1-1).
2. “Minimizing debris generated by accidental explosions”. It concerns design measures to limit accidental explosions that could threaten other spacecraft both during the mission (2-1) and after mission completion (2-2).

3. “Selection of safe flight profile and operational configuration”. It covers the design of a trajectory limiting the risks of collision with large objects during the spacecraft orbital lifetime (3-1), the minimization by design of the risk of loss of control for post-mission disposal due to collisions with debris smaller than 1 cm (3-2) and the requirement of detailed analyses of tether systems (3-3).
4. “Post-mission disposal of space structures”. It defines different methods for post-mission disposal including atmospheric re-entry,² storage orbits and direct retrieval (4-1) and reaffirms the need for special analysis when tether systems are involved (4-2).

A revised version of the ODMSP was announced in November 2019 at the first International Conference on Orbital Debris by Dr J-C Liou, NASA Chief Scientist for Orbital Debris and Program Manager for the NASA Orbital Debris Program Office. Apart from slight modifications on the previously mentioned elements, this revision includes the addition of a preamble and of a fifth part titled “Clarification and additional standard practices for certain classes of space operations”. It covers large constellation (5-1), small satellites (5-2), rendezvous, proximity operation and on-orbit servicing (5-3), active debris removal (5-4) and tether systems³ (5-5) [3]. Further details on the revision process are presented in section 5.6, in particular regarding the choice to keep the 25-year rule instead of a shorter re-entry deadline.

The ODMSP serve as the principal debris-related requirements of space activities subjected to the supervision and control of the US government as explicitly required in the National Space Policy of 28 June 2010.

4.2. The National Space Policy of 2010

On 28 June 2010, US President Barack Obama announced the *National Space Policy of the United States of America*. This *2010 National Space Policy* expresses the “President’s commitment to reinvigorating U.S. leadership in space for the purposes of maintaining space as a stable and productive environment for the peaceful use of all nations” [4]. With a strong focus on space sustainability, this policy reaffirms the importance for the United States to “lead” the development of international standards for debris mitigation and to “continue to follow the United States Government Orbital Debris Mitigation Standard Practices”. It however adds a provision on the granting of exceptions to the ODMSP, stating:

“[The United States shall] require the head of the sponsoring department or agency to approve exceptions to the United States Government Orbital Debris Mitigation Standard Practices and notify the Secretary of State” [5].

The inclusion of this provision is extremely useful from a research standpoint as it provides an indicator for the compliance of DoD activities with the ODMSP. Knowing the procedure by which the Secretary of Defense can provide exemptions, internally called *waivers*, an appropriate FOIA request allows to have a clear overview of the DoD’s approach to space debris mitigation. In the case of the US Air Force, waivers should be requested by the Secretary of the Air Force to the Secretary of Defense. By delegation, the Deputy Secretary of Defense then evaluates the proposal and decides whether to grant the waiver or not. Any approval is then notified to the Secretary of State, either through the Bureau of Oceans and International Environmental and Scientific Affairs’ Office of Space and Advanced Technology, or through the Bureau of Arms Control, Verification and Compliance (there is no official single channel) [US-5].

4.3. Implementation by the DoD and USAF

After the enactment of the 2010 National Space Policy, the DoD implemented measures related to the preservation of the outer space environment by issuing DoD Directive 3100.10 [6], later streamlined in the Department of the Air Force’s (DAF) activities through AF Policy Directive 13-6 [7], AF Policy Directive 91-2 [8], AF Instruction 91-202 [9] and AF Instruction 91-217 [10]. This list is not exhaustive but presents the issuances having a direct implication with the study’s focus. At the time of publication of this paper, the other military departments have not yet implemented their own directives or instructions. Figure 4-2 summarises the structure of the implementation of debris-related measures at the DoD.

² This includes the so-called “25-year rule” requiring the re-entry of an object within 25 years of the completion of its mission.

³ In the November 2019 revision, mentions of tether systems were removed from parts 3 and 4 and combined in point 5-5.

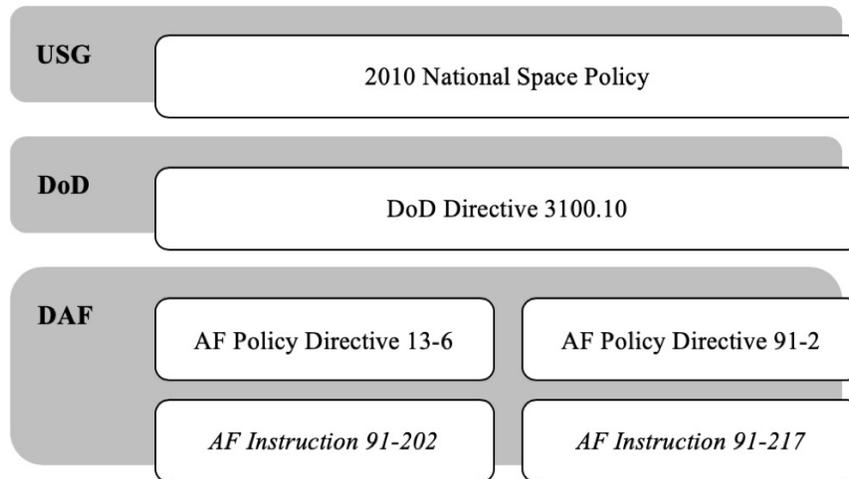


Fig. 2. Implementation of debris-related measures at the DoD and USAF (non-exhaustive)

According to the DoD’s Washington Headquarter Services, DoD Directives are documents issued to “establish policy, assign responsibilities, and delegate authority to DoD Components” and “contain no procedures”, while DoD Instructions provide procedural details for the concrete implementation of the policy by responsible authorities defined in DoD Directives [11]. AF Policy Directives are similar to DoD Directives and AF Instructions to DoD Instructions, at DAF-level. The next subsections introduce the main contributions of some of the aforementioned issuances.

4.3.1. DoD Directive 3100.10: Space Policy

The current DoD Directive 3100.10, enacted on 18 October 2012 by Deputy Secretary of Defense Ashton B. Carter and updated on 4 November 2016, replaced its 1999 version to define the space policy of the DoD in accordance with established space policies of the US government such as the 2010 National Policy and the National Security Space Strategy of 2011 [12]. The directive contains numerous references to “the sustainability and stability of the space environment” (4.b), stating that the DoD, *inter alia*, “will promote the responsible, peaceful, and safe use of space, including following the U.S. Government Orbital Debris Mitigation Standard Practices” (4.d) and “will cooperate with interagency, international, and commercial partners to define and promote safe and responsible space operations” (4.e).

4.3.2. AF Policy Directive 13-6: Space Policy

AF Policy Directive 13-6 is the USAF equivalent of DoD Directive 3100.10 in the sense that it defines the USAF space policy. For what concerns the preservation of the space environment, it roughly mirrors Directive 3100.10 by stating that the USAF “will contribute to the continued sustainable use of space by maintaining knowledge of on-orbit space objects, (...) and complying with US Government Orbital Debris Mitigation Standard Practices” (2.1.2.1) and “will collaborate with interagency, international, and commercial entities to promote safe and responsible space activities” (2.1.2.2).

4.3.3. AF Instruction 91-217: Space Safety and Mishap Prevention Program

AF Instruction 91-217 is a long technical document implementing aforementioned DoD and AF directives. One point is particularly relevant for the analysis of section 5.2, the explanation of the ODMSP waiver request process for USAF launches:

“5.4.3.1. The SDARs [*note: Space Debris Assessment Reports*] shall include an assessment of debris generation risk during launch, on-orbit operations, and EOL disposal, and shall assess compliance with the US Government Orbital Debris Mitigation Standard Practices (ODMSP). All non-compliances with the ODMSP require an approved exception to National Space Policy before launch, as soon as possible following identification. Air Force exception to National Space Policy shall staff through Headquarters Air Force, Space Operations (Air Force/A3S) for Secretary of Defense approval.”

This is exactly the process described in the FOIA answer obtained by the author on 16 October 2019 from the Headquarters Air Force:

“These waivers are requested by the Secretary of the Air Force and granted by the Deputy Secretary of Defense, acting on authority delegated by the Secretary of Defense.”

4.4. Before the National Space Policy of 2010

Prior to the enactment of the 2010 Space Policy, the DoD and NASA already had their own rules on space debris mitigation. In fact, the main change of the 2010 Space Policy was to change the ODMSP waivers’ attribution process, as explained in the successful FOIA answer:

“The 28 June 2010 National Space Policy required that ODMSP waivers be granted by the applicable department head, which for National Security Space meant the Secretary of Defense (who delegated this authority to the Deputy Secretary of Defense). Previously, ODMSP waivers that were needed for National Reconnaissance Office missions were approved by the Director of the National Reconnaissance Office, and ODMSP waivers that were needed for Air Force Space Command missions were approved by the Space and Missile Systems Center commander”.

5. THE DOD’S APPROACH TO SPACE DEBRIS MITIGATION

This section investigates the approach of DoD components and personnel with regards to the mitigation of space debris, through quantitative data on the Air Force’s compliance with the ODMSP and interview-based qualitative information.

5.1. Factual data on the Air Force’s compliance with the ODMSP

Part of this paper’s methodology relies on the use of anonymous sources in the USG. However, only relying on such sources raises issues of validity. It is therefore important to couple the information from interviews with actual verifiable data: in this case, the successful result of a FOIA request.⁴

With this request, the author asked to know the use of ODMSP waivers by the USAF since the enactment of the 2010 National Space Policy. Figure 4-3 presents the results of the FOIA request, provided by the Air Staff’s Office of Operations, Plans and Requirements (AF/A3).

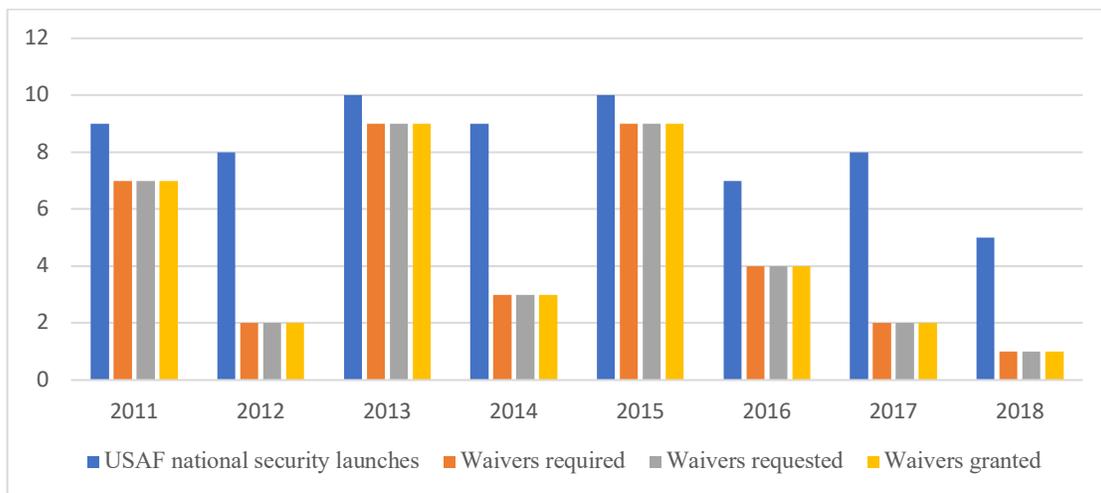


Fig. 3. National security launches carried out by the US Air Force and associated ODMSP waivers (2011-2018)

An interesting aspect of this FOIA is that its results do not correspond to what has been published by Garber in his 2017 paper. He explains that “calendar year 2017 appears to be the first year in which the Air Force did not request any waivers from the Secretary of Defense”. However, when interviewed by the author, a senior OSD official confirmed the veracity of the 2016-2018 FOIA results [US-1]. As for post-2018 data, another OSD interviewee assured the author that the USAF had become fully compliant in late 2018 [US-16].

⁴ All details on the requesting process are presented in appendix A.

At the time of redaction of his paper in early 2017, the information available to Garber was clearly indicating that the USAF reached compliance. In fact, in a memo of 6 February 2017 to the Secretary of the Air Force, then-Deputy Secretary of Defense, Robert O. Work declares:

“I am pleased to learn that the Air Force will achieve full compliance with the U.S. National Space Policy’s requirement to meet the U.S. Orbital Debris Mitigation Standard Practices (ODMSP) for new launches in Calendar Year 2017” [13]

An explanation to this discrepancy could be that the waivers approved for the two Air Force launches made in 2017 were granted *a posteriori*. The lack of information on the exact timeframe of each of the waivers approved by the Deputy Secretary of Defense (date of request, processing time, date of approval, etc.) is the primary motivation for the second FOIA made by the author (19-F-1762).

5.2. Conditions on granting the waivers

While indicating the exact number of waivers granted, the data obtained in the above-mentioned FOIA request does not provide any information on the rationale behind the granting of waivers to the USAF by the Deputy Secretary of Defense. As described in section 3.2, another FOIA request (19-F-1762) was submitted to obtain the full justification of each of the waivers granted from 2011 to 2018 but according to people familiar with the matter, its processing is likely to take years. In the meantime, however, based on interviews of current and past DoD officials, the author was able to identify some of the most frequent conditions of waiver attribution.

Technical issues leading to a violation of the ODMSP but being too expensive to solve in the short-term can lead to the granting of a waiver. For example, without providing the author with precise details, some interviewees explained that the main launcher used by the USAF, the Delta IV rocket, was releasing parts (debris) during specific portions of its flight that were in direct violation with ODMSP requirements [US-38]. As another interviewee puts it, Delta IV launches were typical examples of the “old school legacy space operations (...) with explosive bolts and all this kind of crap”, with very limited environmental concerns [US-15]. Internal DoD studies having shown that fixing the issue would cost in the range of USD 300-500 million, choice was made to provide waivers in the short-term, before transitioning towards cleaner launchers [US-16].

Some waivers are provided based on what US-1 called “resilience features”. For example, mission imperatives can require the satellite to be inserted directly into geo-synchronous orbit, therefore leaving upper stages at a very high altitude [US-16], in direct violation of the ODMSP. In this case, a waiver has to be requested and is normally granted [US-1].

Waivers can be also granted *a posteriori* in case of launch malfunction. A recent Navy launch (details undisclosed) suffered issues during its launch, leading to an excessive use of satellite fuel, making compliance with ODMSP’s post-mission disposal requirement impossible. Therefore, while obtaining a waiver, the Navy was instructed to study the possibility of contracting on-orbit servicing to get compliant with the ODMSP [US-1].

5.3. Explaining the 5-year delay in compliance

First of all, it is important to acknowledge that the data set being relatively limited – only eight years, any trend analysis should be taken with caution. What seems to appear is a decreasing trend started in 2016 and comforted in 2017 and 2018, in line with the explanation of the DoD officials interviewed by the author. One question however remains: why did the decrease start only around 2015-2016?

5.3.1. Military programming and acquisition processes

Military programming and acquisition processes were mentioned by interviewees as the primary – organisational – factor explaining the 5-year delay of the USAF to reach quasi-compliance with the ODMSP. In fact, most USAF satellite projects are developed over five to ten years [US-16]. Even beyond satellite projects, “every time you make a new requirement on defence acquisition people, it takes basically five years to work through, it takes five years because it is what the budget cycle is” [US-13]. It therefore seems logical that projects approved up to 2010 (then launched by 2015) and that did not satisfy ODMSP requirements established by the 2010 National Space Policy, received waivers. Following projects however, developed with the policy in mind, were less likely to require a waiver. Garber also mentions these considerations:

“By the time a spacecraft is almost ready for launch, however, it is by definition much too late to change its construction or reconfigure it for an alternate launch vehicle that might produce less debris. Such factors need to be considered when spacecraft are being designed, not prepared for launch. It would be rather expensive to redesign a spacecraft or even potentially to provide it with additional fuel to maneuver for post-mission disposal. Thus in many cases, the Secretary of Defense and NASA Administrator effectively have had little choice but to approve

exceptions to the rules, especially when critical national security spacecraft are involved (which includes virtually all DoD missions)” [1]

Moreover, as explained in section 5.2, it was extremely complicated and costly for the USAF to go against a legacy of non-compliant Delta IV launchers developed a decade before the enactment of the ODMSP, and for which a full supply chain was developed by the United Launch Alliance (ULA) [US-5]. From 2015 however, SpaceX’s Falcon 9 was certified for national security space launches and took over most of GPS launches previously done using Delta IV. Moreover, from 2018 the USAF simply stopped launching GPS satellites using Delta IV, contracting only Falcon 9 and one of ULA’s other launchers, the Atlas V. This change of launch procurement may explain the decrease of waiver requests from 2016 onwards, that used to be primarily driven by Delta IV [14].

5.3.2. Personal insistence of senior civilian leaders

Another reason for the acceleration of the USAF’s move towards compliance with the ODMSP in the second half of the 2010s is the personal weight put by the Secretary of Defense and/or the Deputy Secretary of Defense (versions differ from one interview to another).

All interviewees agreed on the fact that one of the two highest civilian leaders of the DoD had grown tired of granting similar waivers over the years, without seeing a clear willingness of the USAF to improve its practices. He therefore announced that he would stop attributing similar waivers unless significant progress would be made, in particular regarding the improvement of its launch vehicles by budgeting technical modification for the following year [US-1]. In fact, in the signed waiver document provided by the Deputy Secretary of Defense, the Office of the Deputy Assistant Secretary for Space Policy (OSD/SP) recommended to insert a sentence requiring compliance in the following years [US-16]. To support this vision, Garber quotes the same memorandum of then-Deputy Secretary of Defense Robert O. Work, published in February 2017, in which he instructs the Air Force, “to reach compliance by including the USG ODMSP requirements into future space launch acquisitions strategies and contracts” [1]. This is probably what also led experts from the Aerospace Corporation to claim in 2017, without any information on the source, that “such waivers are increasingly difficult to obtain” [15]. The increased difficulty to get a waiver was confirmed by inside sources interviewed by the author [US-1,15,16,17].

5.4. Cultural evolution in the DoD with regards to debris mitigation

Apart from the direct influence of some civilian leaders on ODMSP waivers, the overall culture of the DoD with regards to space debris mitigation has seen a sharp evolution in the last few decades.

Specific military leaders have been really vocal in support to better practices in outer space, for the preservation of a safe and sustainable environment. Names coming up often during interviews are General John E. Hyten during his tenure as Commander of the USSTRATCOM, now 11th Vice Chairman of the Joint Chiefs of Staff (VCJCS) [US-16], or earlier General James E. Cartwright, himself former USSTRATCOM Commander and 8th VCJCS, who showed during his whole career a keen interest for transparency of space activities and space sustainability, including by handling the 2008 American anti-satellite operation to shoot down faulty NRO spacecraft USA-193 with extreme care for debris generation [US-25].⁵

Moreover, the DoD has progressively increased its presence and influence in international discussions for the preservation of the outer space environment. For example, it played an important role in the Long-Term Sustainability (LTS) guidelines negotiations at the UNCOPUOS. Although all relevant US government agencies participated in the initial expert group, specific DoD staffs stayed for the whole duration of the discussions (several years) and took the *de facto* technical lead for the US government both for the expert group and the following working group [US-16,17], while DoS representatives continue to officially head the delegation, as for all UN-related fora [US-21].

5.5. Countervailing pressures?

Although DoD components have moved towards greater compliance with the ODMSP, the increasingly contested nature of the space domain has led some actors to raise their voices against an excessive focus on space debris with respect to more pressing issues. In particular, the NRO was often cited as an agency putting a strong emphasis on missions, at the expense of the preservation of the outer space environment [US-15]. Whether these opinions expressed about the NRO are based on actual facts or not is the reason why the author submitted FOIA request F-2019-00117.

5.6. Debate over the DoD’s position on the 2019 revision of the ODMSP

⁵ USA-193 was an NRO military reconnaissance satellite having suffered a launch failure and purposely destroyed by the US military to avoid reentry hazards.

The disappointment of the space community over the recent revision of the ODMSP, presented in December 2019 by NASA's Liou during the first International Orbital Debris Conference, led to speculations over the respective positions of the main agencies involved in the working group. In particular, space analyst Theresa Hitchens unveiled an apparent fight between NASA and DoD delegates over the 25-year rules [16]. According to her, DoD experts were pushing for a shorter deadline while NASA wanted to maintain the *status quo*. Liou, leading the interagency working group, later wrote that according to NASA's analysis, "reducing the 25-year rule to, for example, a 5-year rule, only leads to another 10% debris reduction over 200 years, which is not a statistically significant benefit" [17]. In a publication in early 2020, Secure World Foundation expert Brian Weeden emitted doubts about this supposed NASA-DoD opposition, writing that while some at DoD may have been in favour of tighter regulations, it was not, based on discussions he had with DoD officials, a shared position in the department [18].

An anonymous source consulted by the author and familiar with the matter has the following view: the DoD and NASA agreed on the benefit of maintaining the status quo over the 25-year rule while both the DoC and the Federal Aviation Authority (Department of Transportation) favoured a five-year deadline. This source however explained that there were debates within the DoD between the OSD/SP in favour of tighter rules and military operators willing to protect their best interests with laxer rules. The source added that leaks having led to Hitchens's article may have been aimed at supporting the DoD's image as an institution deeply concerned with the long-term sustainability of outer space [US-30].

6. BRIEF COMPARISON WITH NASA'S COMPLIANCE WITH THE ODMSP

This section provides a brief comparison of DoD's and NASA's compliance with the ODMSP. All the data on NASA's compliance and reasons for the cases of non-compliance originate from an official briefing of Liou at the White House's Office of Science and Technology Policy [19].

Contrary to the FOIA data concerning solely USAF rocket launches, NASA provides two types of data: the compliance with the ODMSP of their spacecraft launched in Earth orbit (Fig. 4) and the compliance of the launch vehicles they used (Fig. 5).

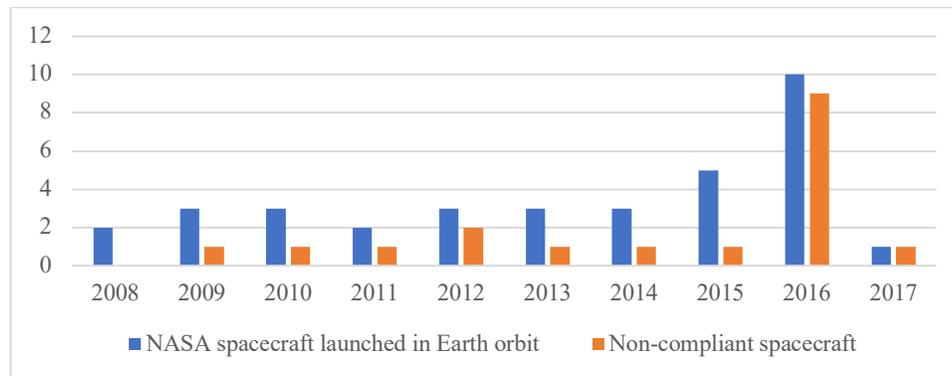


Fig. 4. NASA spacecrafts launched in Earth orbit and compliance with the ODMSP (2011-2017), from [19].

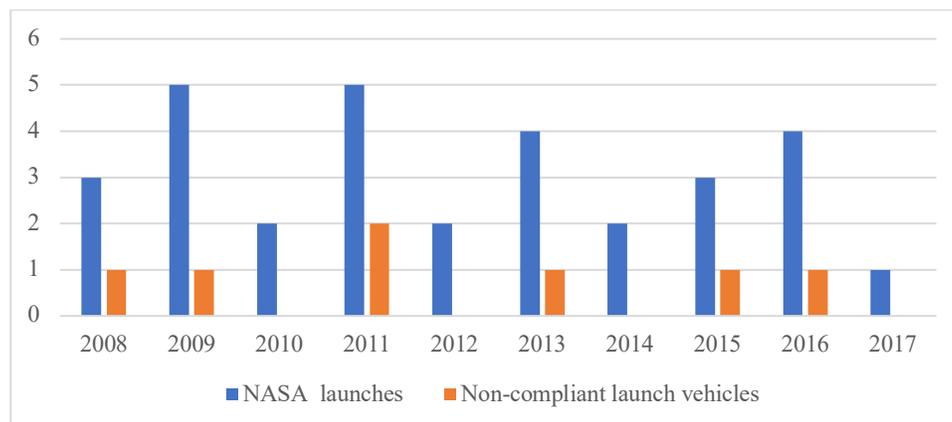


Fig. 5. NASA launches and compliance with the ODMSP (2011-2017), from [19].

In first analysis, it appears that NASA is usually compliant with the ODMSP, with the noticeable exception of 2016 when most of the spacecraft launched required a waiver. It was primarily due to the launch of a set of non-compliant Cyclone Global Navigation Satellite System (CYGNSS) spacecraft, accounting for eight of the nine waivers granted to NASA spacecraft this year (out of ten launched), due to the impossibility to disconnect solar panels from batteries at the end of life of the satellites, hence violating the ODMSP's passivation rules. Apart from this exceptional bump in NASA's compliance, what can explain such a successful track record, and why is there no visible impact of the 2010 Space Policy, even after a certain delay like in the USAF case?

The answer to these questions is twofold. It relates to the origins of the ODMSP as well as to NASA internal practices with regards to orbital debris mitigation. As evoked briefly in section 4.1, the USG ODMSP originate from NASA Safety Standard (NSS) 1740.14, *Guidelines and Assessment Procedures of Limiting Orbital Debris*, adopted internally in 1995 [1]. Moreover, even after the enactment of the ODMSP, NASA continued to further strengthen its internal regulations. Contrary to the DoD that mostly limited itself to endorsing the ODMSP, NASA introduced the NASA Technical Standard NS 8719.14A, *Process for Limiting Orbital Debris* in 2007 and the NASA Procedural Requirements for Limiting Orbital Debris, NPR 8715.6 revision B in 2017 [19]. NASA spacecraft and launches having to comply with these technical standards and requirements, are therefore expected to pass the ODMSP requirements without problem, explaining the good compliance record shown on figures 4 and 5. As for the absence of impact of the 2010 Space Policy, it is simply a consequence of the fact that NASA has been working on its compliance with ODMSP-like rules since 1995 and even on stricter ones since 2007.

Finally, although it is quite rare, what are the mission or design factors usually responsible for NASA spacecraft's non-compliance with the ODMSP? [19] provides three main reasons for the non-compliance of spacecraft launched from 2008 to 2017: issues with end-of-mission passivation (e.g. remaining pressure in tanks, impossible disconnection of batteries and solar panels), violation of the 25-year rule (e.g. NOAA 19 will remain 500 years in orbit) and a re-entry human casualty risk above the limit (e.g. 1 in 600 for MMS Atlas 5, below above the 1 in 10,000 threshold).

7. CONCLUSIONS

The recent evolution of the USAF towards compliance with the ODMSP shows a clear awareness of the DoD on the importance to improve its practices to preserve a safe and sustainable operational environment. Moreover, the role played by the DoD in the creation of the UNCOUOS LTS guidelines demonstrates of its willingness to be seen as a responsible actor in outer space and to contribute to the 2010 Space Policy's requirement to all departments and agencies to "lead in the enhancement of security, stability, and responsible behaviour in space" [5]. This leads to another issue, not fully explored in this paper: if the DoD is willing to be seen as a responsible actor, why not publicising the positive data about its compliance with the ODMSP? As Garber wrote:

"sharing this domestic compliance data internationally would bolster the U.S. Government's deserved reputation as an international leader in debris mitigation and encourage other nations such as China and Russia to collect such data and report them internationally" [1]

When the topic was brought up by the author, most interviewees agreed on the benefits of such approach while pointing out two issues: one is how to ensure reciprocity from other major space powers, and the second is that having no administrative requirement to publicise the data, neither the DoD nor the DoS would assign already overworked staff to the task [US-5].

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10. APPENDIX: LIST OF INTERVIEWEES

Note: the interviewees listed below are only the 10 cited in the text, among the 38 met for the study.

- US-1 Senior Civilian Official. Office of the Secretary of Defense, Department of Defense. 28 August 2019. Arlington, Virginia. Interviewer: Author.
- US-5 Senior Official. Department of State. 3 September 2019. Washington, DC. Interviewer: Author.
- US-13 Senior Official. National Space Council, Executive Office of the President. 9 September 2019. Washington, DC. Interviewer: Author.

- US-15 Senior Policy Advisor. United States Air Force. 9 September 2019. Washington, DC. Interviewer: Author.
- US-16 Senior Civilian Official. Office of the Secretary of Defense, Department of Defense. 10 September 2019. Arlington, Virginia. Interviewer: Author. Interviewed with US-17.
- US-17 Civilian Official. Office of the Secretary of Defense, Department of Defense. 10 September 2019. Arlington, Virginia. Interviewer: Author. Interviewed with US-16.
- US-21 Senior Official. Department of State. 11 September 2019. Washington, DC. Interviewer: Author.
- US-25 Retired General Officer (OF-9). Department of Defense. 16 September 2019. Washington, DC. Interviewer: Author.
- US-30 Space Policy Analyst. 28 February 2020. Tokyo, Japan. Interviewer: Author.
- US-38 Retired Military Officer. United States Air Force. 23 October 2019. Washington, DC. Interviewer: Author.