Nos. 21-1123, -1125, -1128

IN THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

VIASAT, INC.,

*Appellant,*

v.

FEDERAL COMMUNICATIONS COMMISSION,

*Appellee,*

SPACE EXPLORATION HOLDINGS, LLC,

*Intervenor for Respondent*.

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THE BALANCE GROUP,

*Appellant*,

v.

FEDERAL COMMUNICATIONS COMMISSION,

*Appellee,*

SPACE EXPLORATION HOLDINGS, LLC,

*Intervenor for Respondent*.

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On Appeal from the Federal Communications Commission
IBFS File No. SAT-MOD-20200417-00037

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# BRIEF OF APPELLANTS VIASAT, INC. AND THE BALANCE GROUP

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August 6, 2021

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## CERTIFICATE AS TO PARTIES, RULINGS, AND RELATED CASES

### A. Parties and *Amici*

The following are the individuals or entities that participated in the proceedings before the Federal Communications Commission in this matter:

Akiak IRA Council
American Astronomical Society
Astroscale U.S. Inc.
AT&T Services, Inc.
The Balance Group
Cass Cable TV, Inc.
Computer & Communications Industry Association
DIRECTV Enterprises, LLC
DISH Network Corporation
DISH Network LLC
Go Long Wireless, Ltd.
Hughes Network Systems, LLC
INCOMPAS
Kepler Communications Inc.
Kodiak Archipelago Rural Regional Leadership Forum
Kuiper Systems LLC
O3b Limited
Pacific Dataport Inc.
RS Access, LLC
SES Americom, Inc.
Space Exploration Technologies Corp.
Spire Global, Inc.
Story Communications, LLC
Telesat Canada
Viasat, Inc.
Vision Broadband, LLC
WorldVu Satellites Limited, Debtor-in-Possession
Ada Agiak
John Agiak
Lucas Aishanna
Andrea Brower
Jacob Calderwood

Carey Halnier
Kalea Kaleak
Billy Killbear
Jonah Koonce
Kaden Kulukhon
Prof. Andy Lawrence
Jonathan McDowell
Vernon Samson
Collin Solomon
Joel M. Thomas
John Wallace

At present, the parties in this Court are:

Viasat, Inc., appellant/petitioner in Nos. 21-1123, 21-1125
DISH Network Corporation and DISH Network LLC, appellants in No. 21-1127
The Balance Group, appellant in No. 21-1128
Federal Communications Commission, appellee/respondent
United States of America, respondent in No. 21-1125 under 28 U.S.C. § 2344
Space Exploration Holdings, LLC, intervenor for appellee/respondent

### B. Rulings Under Review

The Order of the Federal Communications Commission under review ("Order") is captioned In the Matter of Space Exploration Holdings, LLC; Request for Modification of the Authorization for the SpaceX NGSO Satellite System, *Order and Authorization and Order on Reconsideration*, IBFS File No. SAT-MOD-20200417-00037, Call Signs S2983 and S3018, FCC 21-48 (released April 27, 2021). The Order has not yet been published in the FCC Rcd.

### C. Related Cases

The case on review was not previously before this court or any other court. Counsel are not aware of any other related cases currently pending in this court or

in any other court, other than the consolidated cases: Viasat, Inc. v. FCC, Case No. 21-1125; DISH Network Corp. v. FCC, Case No. 21-1127; The Balance Group v. FCC, Case No. 21-1128.

Dated: August 6, 2021

Respectfully submitted,

/s/ *William M. Jay*
William M. Jay

## VIASAT CORPORATE DISCLOSURE STATEMENT

Pursuant to Federal Rule of Appellate Procedure 26.1 and Circuit Rules 26.1 and 27(a)(4), Viasat, Inc. states that it has no parent company and that no publicly held company has a 10% or greater ownership interest (such as stock or partnership shares) in Viasat, Inc.

Dated: August 6, 2021

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## THE BALANCE GROUP CORPORATE DISCLOSURE STATEMENT

Pursuant to Federal Rule of Appellate Procedure 26.1 and Circuit Rules 26.1 and 27(a)(4), The Balance Group states that it has no parent company and that no publicly held company has a 10% or greater ownership interest (such as stock or partnership shares) in The Balance Group.

Dated: August 6, 2021

Respectfully submitted,

/s/ *Michael F. Smith (by permission)*

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## GLOSSARY OF TERMS

| | |
|---|---|
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| Environmental Appellants | Viasat, Inc. and The Balance Group |
| FAA | Federal Aviation Administration |
| FCC or Commission | Federal Communications Commission |
| LEO | Low-Earth Orbit |
| NEPA | National Environmental Policy Act |
| SpaceX | Space Exploration Holdings, LLC |
| Application | Third Modification Application |

## INTRODUCTION

In a single decision, the Federal Communications Commission authorized Space Exploration Holdings, LLC ("SpaceX") to deploy more satellites in the next 15 years than have been launched, *total*, in all of human history—and did so without even assessing the environmental impacts of that dramatic authorization. *By design*, these satellites will be deployed into low-earth orbit, function for a few years, and then burn up in the atmosphere. The results are both startling and largely incontrovertible: Millions of pounds of pollutants will be dumped into the atmosphere, where they will affect climate change and harm the ozone layer. Thousands of sunlight-reflective satellites will pollute the night sky. And failed, uncontrollable satellites may collide with other objects in space and create more debris—and exponentially more collisions—that could make low-earth orbit unusable for a lifetime or more.

If there were ever an agency action calling out for review under the National Environmental Policy Act ("NEPA"), this is it. Indeed, the Commission itself recognizes that NEPA requires at least an environmental assessment ("EA") if an authorization "*may* have a significant environmental impact," a standard that is easily met on this record. 47 C.F.R. § 1.1307(c) (emphasis added). Yet the Commission inexplicably concluded that an environmental assessment was unnecessary here because the Commission was *uncertain* as to the environmental

impacts of its authorization. That conclusion rests on legal error and arbitrary decisionmaking.

The Commission's Order allows SpaceX to deploy 2,824 additional operating satellites into low-earth orbit, plus an unlimited number of replacements as satellites reach the end of their five-year design lives—or fail, as SpaceX's satellites have already done with alarming frequency. Even the Commission acknowledged the "unprecedented scale" involved. [Order.¶58]; *see also* [Viasat.Pet.Ex.18.at.1 n.1]; [Viasat.Pet.Ex35.at.61000]. SpaceX has chosen to operate at that scale because its model depends on cheap construction, short useful life, and disposal in the atmosphere—externalizing environmental costs for everyone else to bear. Indeed, since the Commission's Order, scientists have continued to sound the alarm about SpaceX's proposed deployment, warning that it "risks multiple tragedies of the commons, including tragedies to ground-based astronomy, Earth orbit, and Earth's upper atmosphere."[1]

Viasat and the Balance Group ("Environmental Appellants") explained, through hundreds of pages of briefing and more than 1,500 pages of academic studies and other exhibits, that SpaceX's "unprecedented" deployment of low-earth orbit satellites at the very least *may* impact the environment by polluting the

[1] A. Boley & M. Byers, *Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth*, at 1, Scientific Reports (May 20, 2021), https://www.nature.com/articles/s41598-021-89909-7.

atmosphere, altering the night sky, and littering both space and Earth's surface with dangerous debris. [Order.¶58]. Under NEPA, the Commission was required at least to consider these potential environmental harms and require an environmental assessment prior to granting SpaceX's application.

This Court should vacate the Commission's Order. On this extensive record, "there is no real dispute" that granting SpaceX's modification *may* have a significant environmental impact over the 15-year term. *American Bird Conservancy v. FCC*, 516 F.3d 1027, 1033 (D.C. Cir. 2008). Indeed, that some impact will occur is basically conceded; the Commission decided not to require an environmental assessment because it was unsure about the extent of that impact and because SpaceX purportedly was trying to mitigate certain harms. But as this Court has already held, correcting a similar legal error by the same agency, to let apparent uncertainty cut against environmental review reflects a "misunderstanding of the nature of the obligation imposed by [NEPA]." *Id.* at 1033-1034. And the Commission's decision rests on nothing else; it responded to Environmental Appellants' arguments not with an explanation, but with conclusory statements that those arguments were somehow "insufficient" or otherwise "failed to set forth in detail reasons justifying or circumstances necessitating environmental consideration." [Order.¶¶ 82, 87]. That is not the "well-considered

decisionmaking" NEPA requires before an agency action of this magnitude. *WildEarth Guardians v. Jewell*, 738 F.3d 298, 302 (D.C. Cir. 2013).

The Commission leaped without a proper look—and the environmental damage may be incalculable. This Court should vacate the Commission's decision and remand for the required NEPA analysis.

## STATEMENT OF JURISDICTION

This Court has jurisdiction under 47 U.S.C. § 402(b)(6), because each Environmental Appellant is aggrieved "by an[] order of the Commission granting … an[] application described in" 47 U.S.C. § 402(b)(1)-(2)—here, SpaceX's application under 47 U.S.C. §§ 308-309 for a "modification" of a "station license."[2]

## STATEMENT OF THE ISSUES

1. Whether the Commission's Order is contrary to NEPA and 47 C.F.R. § 1.1307(c)—which require an environmental assessment whenever an action "may have a significant environmental impact"—because the Commission erroneously relied on uncertainty as a basis for refusing to require such an assessment.

[2] Viasat also filed a Protective Petition for Review to alternatively invoke jurisdiction under 47 U.S.C. § 402(a) and 28 U.S.C. § 2342(1). *See PSSI Global Servs., LLC v. FCC*, 983 F.3d 1, 6 (D.C. Cir. 2020).

2. Whether, in light of the Commission's failure to require an environmental assessment and to explain its decision adequately, the Order was arbitrary, capricious, and an abuse of discretion.

## RELEVANT STATUTORY AND REGULATORY PROVISIONS

The Addendum contains the relevant statutory and regulatory provisions. Add42-54.

## STATEMENT OF THE CASE

### I. NEPA requires environmental review before major federal actions.

Congress enacted NEPA to ensure that federal agencies consider "the critical importance of restoring and maintaining environmental quality," as part of "the responsibilities of each generation as trustee of the environment." 42 U.S.C. § 4331. NEPA thus "places upon an agency the obligation to consider every significant aspect of the environmental impact of a proposed action," ensuring "fully informed and well-considered decisionmaking." *WildEarth Guardians*, 738 F.3d at 302 (citation omitted).

To fulfill these goals, NEPA requires that federal agencies include "a detailed statement" regarding the environmental impact of any "major Federal actions significantly affecting the quality of the human environment."[3] 42 U.S.C. § 4332(2)(C). If an action is "not likely to have significant effects or when the

significance of the effects is unknown," the agency must at least prepare an environmental assessment to determine whether a more rigorous environmental impact statement ("EIS") is necessary. 40 C.F.R. §§ 1501.3(a)(2), 1501.5(c)(1). In addition, an agency can determine that a "category of actions" *ordinarily* does not have a significant environmental impact and hence does not require even an environmental assessment—known as a "categorical exclusion." *Id.* § 1501.4. But the agency must adopt procedures to address "extraordinary circumstances in which a normally excluded action *may* have a significant environmental effect." *Id.* § 1507.3(e)(2)(ii) (emphasis added); *see also id.* § 1501.4(b). While most agencies identify specific categories of excluded actions, the Commission has, since 1986, excluded *all* of its actions from NEPA review, identifying only a small number of limited exceptions in its regulations. *See* 47 C.F.R. § 1.1306.

One of those regulatory exceptions allows an "interested person" to file a petition requesting an environmental assessment even when a Commission action otherwise falls within an excluded category. 47 C.F.R. § 1.1307(c). If the evidence submitted shows that the particular action "*may* have a significant environmental impact," the Commission "*will require* the applicant to prepare an EA." 47 C.F.R. § 1.1307(c) (emphases added). The regulations require no

[3] A "major Federal action" includes an "[a]pproval of [a] specific project[]" by "permit or other regulatory decision." 40 C.F.R. § 1508.1(q)(3)(iv).

separate showing of "extraordinary circumstances"; the "'may' standard" constitutes the Commission's "procedures" for identifying such circumstances. *Id.*; *see also* 40 C.F.R. § 1507.3(e)(2)(ii); *American Bird Conservancy*, 516 F.3d at 1032-1034. This Court has held that, given the "'may' standard" in the Commission regulation, uncertainty concerning the environmental impact of a Commission action "confirms, rather than refutes," the need for a NEPA assessment despite an otherwise-applicable categorical exclusion. *American Bird Conservancy*, 516 F.3d at 1033-1034.

## II. SpaceX persuades the Commission to let it deploy thousands of satellites without any environmental review.

This appeal concerns SpaceX's efforts to deploy 2,824 satellites—plus unlimited replacements—in low-earth orbit. As the Commission recognized, given the satellites' short lifespan and high failure rate, authorizing SpaceX to operate 2,824 satellites means authorizing SpaceX to deploy approximately 10,000 satellites over the full fifteen-year license term—and every satellite SpaceX deploys is ultimately intended to burn up in the Earth's atmosphere. [Order.¶63]. Many more satellites may follow: SpaceX ultimately seeks authority to operate 42,000 satellites at any time. [Order.¶78].

In two licensing decisions in 2018, the Commission gave preliminary approval for SpaceX to deploy a satellite constellation comprising approximately 12,000 operating satellites, including the nearly 3,000 at issue here. *Space Expl.*

*Holdings, LLC*, 33 FCC Rcd. 3391, 3391 (2018); *Space Expl. Holdings, LLC*, 33 FCC Rcd. 11,434, 11,435 (2018). SpaceX intends to use that constellation to provide satellite-based internet services under the name Starlink.[4] *See, e.g.*, [Order.¶¶9, 13]. But the Commission's 2018 decisions did not finally authorize SpaceX to deploy *any* satellites; SpaceX had to make additional license modification applications. [Order.¶¶2, 79]. SpaceX's "Third Modification Application" ("Application")—the application at issue here—sought final authorization to deploy a specific tranche of 2,824 low-earth orbit satellites. [Order.¶4].

Invoking NEPA and Section 1.1307(c), Environmental Appellants argued that, because SpaceX's deployment "may have a significant environmental impact," SpaceX's application required an environmental assessment even though it otherwise fell within an excluded category. *E.g.*, [Viasat.Pet.at.7]; [Balance.Group.Opposition(Corrected).at.13]. Through thousands of pages of exhibits and more than a hundred pages of briefing, Environmental Appellants documented multiple environmental effects that SpaceX's concededly "unprecedented" deployments ([Order.¶58]) will cause.

[4] SpaceX has also requested authority to deploy 30,000 more satellites as part of the Starlink system. *See* Application for Fixed Satellite Service, Attachment A at 1, IBFS File No. SAT-LOA-20200526-00055 (May 26, 2020), https://fcc.report/IBFS/SAT-LOA-20200526-00055/2378671.

First, Environmental Appellants introduced evidence that launch and reentry of Starlink satellites will release harmful chemicals and metallic compounds into the atmosphere, contributing to climate change and ozone depletion. Aluminum oxide, also known as alumina, is one such harmful compound. Starlink satellites are primarily made of aluminum, and the components that combust upon reentry will deposit millions of pounds of alumina in the stratosphere. [Viasat.Pet.Ex.15].[5] The Aerospace Corporation, a nonprofit dedicated to advising the government on space enterprise, described the alumina deposits from satellite reentry as having the "capability to warm Earth's atmosphere" and "pos[ing] a global threat" due to alumina's "ability to deplete ozone." [Viasat.Pet.Ex.15]. Another study described alumina as "a unique source of lower stratospheric heating during winter that could warm the dark tropopause; even small changes in this situation might lead to large effects." [Viasat.Pet.Ex.14.at.187].

Another study concurred that "[r]ocket combustion products" released during satellite launches, such as soot, "have a significant potential to become a significant contributor to the problem of stratospheric ozone depletion." [Viasat.Pet.Ex.12.at.52, 54, 59-60, 63]. These products "are the only human-

[5] There is also a substantial risk that these satellites will *not* fully combust—in which case the "significant hazard to people, both on the ground and in aircraft," from "the yearly reentry of large numbers of satellites" is "evident." [Viasat.Pet.Ex.17.at.13]; *see also* pp. 34-37, *infra*.

produced source of ozone-destroying compounds injected directly into the middle and upper stratosphere." [Viasat.Pet.Ex.12.at.52]. This is important both because the ozone layer exists in the stratosphere and because the stratosphere "is relatively isolated from the troposphere," so particles released in the stratosphere will stay there and have a "cumulative effect." [Viasat.Pet.Ex.12.at.52]. Moreover, because of the nature of the reactions at issue, "[d]eposition of relatively small absolute amounts of these reactive compounds can significantly modify ozone levels." [Viasat.Pet.Ex.12.at.52]. These same combustion products will also contribute to global warming. [Viasat.Pet.Ex.14].

Second, Environmental Appellants introduced evidence showing that Starlink satellites will create light pollution—both by increasing background light ("skyglow") and by adding thousands of individual, light-reflective objects visible from the ground. *See* [Viasat.2021.04.16.Letter.at.4-6]. Numerous studies, including a detailed United Nations report, have explained how both forms of light pollution will "fundamentally change the view of the night sky for almost everyone on the planet." [Viasat.Reply.Ex.13.at.28]. This will cause a particular problem for astronomical observations: Starlink and similar satellite constellations will "fundamentally change astronomical observing," [Viasat.Pet.Ex.19.at.3-4], leading to "dramatic" results, [Viasat.Reply.Ex.13.at.15], that will "severely harm ground

based astronom[y]" and lead to "a dramatic degradation of the scientific content for a huge set of astronomical observations," [Viasat.Pet.Ex.24.at.1-2].

Increased light pollution also adversely affects human health, human activities such as celestial navigation, and flora and fauna. [Viasat.Pet.Ex.21]; [Viasat.Pet.Ex.22]; [Viasat.Reply.Ex.13.at.16]; [Balance.Group.Opposition(Corrected).at.10-11]; [Viasat.Petition.Ex.20.at92]. The significant impacts of increased light pollution on animal and plant life have been well documented, *e.g.*, [Viasat.Reply.Ex.13.at.102-109], with one report noting the particular impact on "animal and insect life" from satellites in low-earth orbit, [Viasat.Reply.Ex.13.at28]. There may be additional impacts on migrations of birds, turtles, salmon, whales, and dolphins, and the nesting and spawning activities necessary for their survival and the survival of other plants and animals that depend on them. [Balance.Group.Opposition(Corrected).at.13]; [Viasat.Reply.Ex.13.at.102].

Finally, Environmental Appellants explained that the increased number of satellites will significantly elevate the risk of satellite collisions, polluting space and threatening additional harms in orbit and on Earth. One study explained that "orbital debris" from constellations in low-earth orbit poses "a growing and potentially catastrophic threat." [Viasat.Pet.Ex.34.at.1]. Another report stated that there is a "high probability" of a "catastrophic collision" involving a constellation

like Starlink. [Viasat.Pet.Ex35.at.61008]. Indeed, even the Commission has recognized that even one collision could have a "catastrophic" effect, producing "a large amount of additional debris … dispersed over a wide orbital area," which could trigger yet more catastrophic collisions. *Mitigation of Orbital Debris*, 19 FCC Rcd. 11,567, 11,570 (2004). Orbital regions could thus reach "a 'runaway' status," at which point they become unusable due to the "collision hazard." *Mitigation of Orbital Debris in the New Space Age*, 35 FCC Rcd. 4156, ¶4 & n.6 (Apr. 24, 2020).

Despite the copious evidence of substantial environmental impacts, the Commission refused to require even an environmental assessment. [Order.¶77]. And the Commission disposed of these concerns in only a few sentences (apart from its summary of the parties' positions). Moreover, the Commission implicitly recognized that there was at least *some* risk of significant environmental impact: It acknowledged that deorbiting satellites will "affect the chemicals entering the atmosphere," [Order.¶82], and that it needed to "continue[] monitoring" *both* orbital debris *and* light pollution, [Order.¶¶64, 87, 97(u)]. Yet the Commission concluded that there was still no need for an environmental assessment because Environmental Appellants had not established with certainty the precise extent of environmental harm.

## SUMMARY OF ARGUMENT

The Commission approved SpaceX's application without the "well-considered decisionmaking" NEPA requires. *WildEarth Guardians*, 738 F.3d at 302. Environmental Appellants presented overwhelming evidence that deploying thousands of satellites into low-earth orbit at the very least *may* impact the environment. Yet the Commission did not even require SpaceX to prepare an environmental assessment because it concluded that SpaceX's unprecedented deployment of thousands of satellites did not even create the *potential* for a significant environmental impact. The Commission largely ignored Environmental Appellants' arguments and evidence and resolved every putative uncertainty in favor of SpaceX's unsupported assertions. The Commission's scant reasoning on this point directly conflicts with binding D.C. Circuit precedent correcting the Commission's misunderstanding of NEPA.

Environmental Appellants specifically identified several categories of environmental impacts, each of which independently necessitates further review under the applicable "may" standard.

First, when SpaceX's satellites deorbit and combust (as they will, by design, with great frequency), their aluminum components react with oxygen in the atmosphere to produce alumina. Alumina contributes to ozone depletion and climate change. Notably, the Commission did not contest these points. Nor, for

that matter, did SpaceX. Rather, SpaceX disputed the record evidence concerning just how much alumina its satellites would produce, and asserted that it would be no more than 2 *million* pounds. Despite acknowledging—and declining to resolve—a dispute over the amount of alumina Starlink will deposit in the atmosphere, the Commission decided no further review was needed. The agency also largely ignored multiple other documented effects from satellite launch and reentry, refusing to peek under the hood to consider the risk of potential human casualty from pieces of satellite that do not disintegrate in the atmosphere, or the further atmospheric harm caused by the many rocket launches required to put Starlink satellites in orbit in the first place.

Second, Starlink's satellites will lead to an appreciable increase in light pollution, with a host of negative consequences for the environment—including significant adverse impacts on professional astronomers and amateur stargazers as well as human, animal, and plant health and activities. The agency recognized this risk, but chose not to assess it because SpaceX is purportedly attempting to mitigate this problem. The agency never considered, however, whether SpaceX's mitigation efforts have been fully implemented (they have not), or whether, if they are ever implemented, they will actually resolve any potential environmental effect (they will not). Indeed, there is evidence that the mitigation *itself* may cause additional environmental damage.

Third, SpaceX's satellites will appreciably raise the risk of catastrophic collisions. Among other things, the risk of collisions is exacerbated by the expected and actual failure rates of the SpaceX satellites, which will render many unable to maneuver to avoid collisions before they ultimately deorbit. Again, the Commission acknowledged this risk—and acknowledged the dispute over precisely how large it will be—but suggested that it need only monitor the situation.

The Order's insistence on forging ahead without confronting these risks of environmental harm is precisely what NEPA is designed to prevent. The statute—and the agency's own regulations—clearly require the Commission to evaluate such risks *before* allowing SpaceX to take the largely irreparable step of deploying thousands of satellites into space.

## STANDING

Environmental Appellants both have Article III standing to challenge the Commission's failure to comply with NEPA. If either Viasat or The Balance Group has standing, the Court "need not consider the standing of the other [appellant]." *Mountain States Legal Found. v. Glickman*, 92 F.3d 1228, 1232 (D.C. Cir. 1996).

Article III standing requires (1) an "injury in fact," (2) that is caused by the challenged conduct, and (3) that will likely be redressed by a favorable decision.

*WildEarth Guardians*, 738 F.3d at 305 (citing *Lujan v. Defenders of Wildlife*, 504 U.S. 555, 560-561 (1992)). In a NEPA challenge, there must be a causal chain with "two links: one connecting the omitted [NEPA review] to some substantive government decision that may have been wrongly decided because of the lack of [adequate NEPA review] and one connecting that substantive decision to the plaintiff's particularized injury." *Id.* Redressability largely overlaps with causation: The challenger's injury is redressable if the agency "could change its mind" if it "adequately consider[s] … environmental concern[s]." *Id.*; *accord American Rivers v. FERC*, 895 F.3d 32, 42 (D.C. Cir. 2018). An association can establish standing "on behalf of its members when: (1) its members would otherwise have standing to sue in their own right; (2) the interests it seeks to protect are germane to the organization's purpose; and (3) neither the claim asserted nor the relief requested requires the participation of individual members in the lawsuit." *Nat'l Lifeline Ass'n v. FCC*, 983 F.3d 498, 507-508 (D.C. Cir. 2020) (citation omitted).

## I. The Order inflicts injury-in-fact on The Balance Group and its members.

The Balance Group exists to provide a balanced approach to proposed man-made systems and their impact on the human condition and the environment at large. Its members include astronomers, physicists, scientists, environmentalists, technologists, telecommunications experts and medical professionals, among

others. Add37-38. The Balance Group's work is designed to protect industry, humans, flora, fauna, and the environment from preventable environmental harms. Add38. The Balance Group's advocacy seeks to ensure that satellite and terrestrial broadband and other radio-frequency transmission networks are subjected to proven, peer-reviewed science, to reduce systemic risks to industry, human beings, and the environment. Add38.

The Commission's Order imposes injury-in-fact on Balance Group members. Add1-5; Add32-35; *see Sierra Club v. FERC*, 827 F.3d 59, 65 (D.C. Cir. 2016). One example is Christopher Baddiley, Ph.D., a professor of astrophysics, a Fellow with the Royal Astronomical Society, and a member of the International Astronomical Union. Add1-2. As part of his research he has imaged the sky every 30 seconds on the darkest of nights. Add2. He creates and stores night-sky images on all clear nights, and has created a voluminous archive of sky imaging that forms the basis of his many projects and statistical analyses. Add2. Increased light pollution from satellite mega-constellations has directly impeded his research, and the situation is worsening. Add2-3. These effects are especially harmful on clear nights, when his efforts to obtain images and data are marred by 1-2 low-earth orbit satellite crossings over any 30-minute period, away from midnight. Add3. He also operates an all-sky camera and has sequential images of

the SpaceX Starlink satellite constellations; the net effect is a "significant impact" on his Astro imaging projects. Add3.

According to Dr. Baddiley, the situation "is getting worse and will be far worse as more satellite[s] are launched…." Add3. Mitigation measures on the Starlink satellites have only reduced the brightness slightly while at the same time increasing infrared emissions. Add4. His research efforts are thus directly frustrated and injured by SpaceX satellites, and the problem is getting worse. *See Am. Friends Service Committee v. Webster*, 485 F. Supp. 222, 226 (D.D.C. 1980) (plaintiffs had standing where agency's actions would hinder their ability "to carry out research in their … professional fields").

Another injured Balance Group member is Roger Malina, Ph.D., a physicist and astronomer, and currently a physics professor at the University of Texas at Dallas. His astronomical work, like Dr. Baddiley's, is "significantly inhibit[ed]" by the Order. Add32-35.

The Commission's Order also inflicts injury-in-fact on The Balance Group directly because it "injured [The Balance Group's] interest," and the Balance Group has "used its resources to counteract that harm." *PETA v. USDA*, 797 F.3d 1087, 1094 (D.C. Cir. 2015). The Balance Group's interests are clearly impacted by the Commission's authorization of the launch of approximately 10,000 satellites over the course of the fifteen-year license term. And The Balance Group has

already "used its resources" to counteract that harm: It has had to redeploy equipment and personnel away from other mission-critical projects, at a cost to date of at least $10,000 (not including these proceedings), which is certain to increase. Add38-41. This constitutes injury in fact for standing purposes. *Carpenters Indus. Council v. Zinke*, 854 F.3d 1, 5 (D.C. Cir. 2017); *Czyzewski v. Jevic Holding Corp.*, 137 S. Ct. 973, 983 (2017) ("For standing purposes, a loss of even a small amount of money is ordinarily an 'injury.'"); *see also Am. Anti-Vivisection Soc'y v. USDA*, 946 F.3d 615, 619 (D.C. Cir. 2020) (organization had standing where agency's failure to issue regulations caused a "drain on the organization's resources") (citation omitted).

## II. The Order inflicts injury-in-fact on Viasat.

Viasat develops and provides satellite communications technologies for both military and commercial use. Add8. Viasat's business depends on its ability to safely access and utilize space. The Commission's decision injures Viasat in at least three ways.

*First*, Viasat's satellites are endangered by the substantially increased risk of catastrophic collisions in low-earth orbit that the Commission's order creates. As the Commission recognized, Starlink satellites fail at a troublingly high rate. Failed, non-maneuverable satellites present "a collision risk for as long as they remain in orbit." [Order.¶¶62-63]. Over the course of the SpaceX's 15-year

license term, the cumulative collision risk from the significant number of failed Starlink satellites could be as high as one in 44.5. [Order.¶63].

Any single collision would have a catastrophic impact on satellite operations in low-earth orbit (and likely other orbits too). Even collisions involving small objects "can produce a large amount of additional debris, which can be dispersed over a wide orbital area" and lead to further collisions. *Orbital Debris*, 19 FCC Rcd. at 11570. Each successive collision exponentially increases the risk of another in-orbit collision. [Viasat.Pet.Ex30.at.7]; Add27.

Both failed SpaceX satellites and debris from a collision involving a SpaceX satellite could damage, disable, or destroy Viasat's own satellites. Viasat already operates at least one satellite at the same altitude as Starlink. Add10, Add28. Viasat is under contract with the Department of Defense to operate an additional high-value satellite in the same orbital range as the Starlink satellites, which Viasat intends to launch in the next six-to-twelve months. Add10, Add28. And Viasat has a pending modification application to deploy 288 satellites in low-earth orbit above SpaceX's satellites. Add10; [Viasat.Jan.15.2021.Letter.Attachment].

The substantially increased collision risk that SpaceX's deployment causes, combined with the likely catastrophic impact of such a collision on Viasat's operations, establishes threatened injury-in-fact to Viasat. [Viasat.Pet.Ex.35.at.61008] (explaining that the "most critical concern for every

space concern entity" is the "impact [of constellations like Starlink] on the space debris environment"); [Viasat.Pet.Ex.34.at.1] (due to constellations like Starlink, satellite networks "face a growing and potentially catastrophic threat: orbital debris"). Here, the "increase in the risk of harm" is "substantial," and the harm itself would be "severe," meaning that even "relatively modest increments in risk should qualify" as injury-in-fact. *Public Citizen, Inc. v. NHTSA*, 489 F.3d 1279, 1296 (D.C. Cir. 2007); *Mountain States Legal Found.*, 92 F.3d at 1235. This Court recently held, in a NEPA case, that "increased risks"—there, to water quality and endangered species—"satisfy the injury-in-fact requirement" because, if those potential harms came to pass, they would injure the challengers' recreational interests. *American Rivers*, 895 F.3d at 41. The "increased risks" Viasat faces likewise satisfy that requirement.

*Second*, even without satellite failures or catastrophic collisions, the Order will increase the cost and complexity of Viasat's own satellite deployments by creating a more crowded orbital environment. More SpaceX satellites in low-earth orbit means scarcer, less frequent launch windows for Viasat and every other operator. Add29-30; [Viasat.Pet.Ex35.at.61001] (describing "the saturation of space resources such as orbital slots and frequencies that could limit the accommodation of many more satellites in the future" as a "significant … concern" caused by constellations like Starlink). Viasat must expend time and resources

ensuring that its various satellite launches and operations during SpaceX's fifteen-year license term avoid collisions caused by any of the thousands of Starlink satellites. *See* Add10, Add28-30. "[E]xpend[ing] resources in response to, and to counteract, the effects of the defendants' alleged unlawful conduct" is "a concrete and demonstrable injury[.]" *PETA*, 797 F.3d at 1097 (citations and brackets omitted)).

*Third*, SpaceX has stated explicitly that it intends to use its environmentally irresponsible Starlink constellation to compete with Viasat. Add30-31. This Court has repeatedly recognized that "parties suffer constitutional injury in fact when agencies lift regulatory restrictions on their competitors." *La. Energy & Power Auth. v. FERC*, 141 F.3d 364, 367 (D.C. Cir. 1998); *see also, e.g.*, *Washington Alliance of Technology Workers v. DHS*, 892 F.3d 332 (D.C. Cir. 2018); *Sherley v. Sebelius*, 610 F.3d 69 (D.C. Cir. 2010); *MD Pharm., Inc. v. DEA*, 133 F.3d 8 (D.C. Cir. 1998). The Order inflicts injury-in-fact by forcing Viasat to compete with a rival that skirted legally required environmental review and whose business model depends on externalizing environmental costs for Viasat and other space users to bear.

## III. Environmental Appellants satisfy the remaining standing requirements.

The Order is causing Environmental Appellants' injuries, and correcting the Commission's NEPA error would redress those injuries. *See WildEarth*

*Guardians*, 738 F.3d at 305. Under the "relaxed" standard for showing a procedural injury is redressable, *id.* at 306, it is enough that "if the Commission is required to adequately consider each environmental concern, it could change its mind about issuing the [modification]." *American Rivers*, 895 F.3d at 42 (citation and brackets omitted).

In the unlikely event that its direct economic harm does not establish standing, The Balance Group satisfies the additional requirements for organizational standing. Stopping the continued deployment of satellites in the Starlink system, and/or removing them from their current low-orbital altitudes, would mitigate if not cease entirely the damage to Dr. Baddiley and Dr. Malina's research work. Add2-4; Add34-35. And since Dr. Baddiley and Dr. Malina would each have standing to sue in his own right, The Balance Group has associational standing, because their interests are germane to The Balance Group's purpose and neither the claim asserted nor the relief requested requires the association's members to participate as individuals. *Nat'l Lifeline Ass'n.*, 983 F.3d at 507-508.

## ARGUMENT

### I. The Order erroneously relied on uncertainty as a reason to *refuse* further assessment and provided no other reasoning that even suffices for judicial review.

The Commission's Order suffers from two overarching flaws. First, the Commission improperly relied on uncertainty as a reason to *deny* NEPA review.

Second, that legally erroneous reasoning aside, the Commission did not adequately explain the basis for refusing to require an EA.

As this Court has recognized, because the question is whether an action "*may* have a significant environmental impact," uncertainty cannot cut *against* environmental review. In *American Bird Conservancy*, this Court vacated a Commission order declining to review the environmental effects of communication towers on migratory birds. 516 F.3d at 1029. The Commission had provided two reasons for not undertaking further review: a "lack of specific evidence" regarding the effect of communication towers, and a "lack of consensus among scientists regarding the impact of communications towers on migratory birds." *Id.* at 1033. This Court rejected both, explaining that "they demonstrate an apparent misunderstanding of the nature of the obligation imposed by" NEPA. *Id.* The Commission's "demand for definitive evidence of significant effects," and specifically for "a 'scientific showing that the population of any specific bird species ha[d] decreased,'" "plainly contravene[d] the 'may' standard" in the Commission's own regulations. *Id.* (quoting 21 FCC Rcd. 4462, 4466 ¶9 (Apr. 13, 2006)). So, too, did the Commission's focus on "scientific consensus [as] a precondition to NEPA action." *Id.* Thus, this Court concluded that the Commission's approach would "jeopardize NEPA's purpose to ensure that

agencies consider environmental impacts before they act rather than wait until it is too late." *Id.*

Despite that "admoni[tion]" from this Court, *id.*, the Commission made the same mistake here. As explained in detail below, the Commission brushed aside extensive record evidence documenting both extant and potential environmental harms with a few vague sentences that did little more than identify potential uncertainty concerning the extent of the relevant environmental impact. Indeed, the Commission implicitly recognized the serious *potential* for harm by requiring "continued monitoring" of both light pollution and orbital debris to protect the "public interest." [Order.¶¶64, 87]. The Commission also repeatedly acknowledged disputes between the parties over critical facts affecting the level of environmental impact—disputes the Commission declined to resolve. [Order.¶¶61, 80]. Thus, as in *American Bird Conservancy*, the Commission erred by treating uncertainty as a reason *not* to require further review.

Leaning on that erroneous application of the law, the Commission entirely failed to give the required "satisfactory explanation for its action[,] including a rational connection between the facts found and the choice made." *Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983). Agency action is "arbitrary and capricious" if the agency "relied on factors which Congress has not intended it to consider [or] entirely failed to consider an

important aspect of the problem." *Id.* The agency's explanation must be sufficiently detailed to provide a basis for judicial review; otherwise, "its action is arbitrary and capricious and so cannot carry the force of law." *Encino Motorcars, LLC v. Navarro*, 136 S. Ct. 2117, 2125 (2016). The Order demonstrates just such a failure to consider and to explain.

In the face of extensive evidence of potential environmental harms, the Commission buried its head in the sand. It did not meaningfully engage with Environmental Appellants' submissions, which were supported by copious evidence. Instead, it rejected Environmental Appellants' evidence in cursory fashion. While the Commission's Order may appear detailed at first glance, a closer look reveals that almost its entire NEPA discussion merely summarizes the parties' arguments. Because the Commission failed to follow that summary with an explanation of its view of the evidence or which arguments carried the day, the "path" to its ultimate decision cannot "reasonably be discerned." *Bowman Transp., Inc. v. Ark.-Best Freight Sys., Inc.*, 419 U.S. 281, 286 (1974).

To take one example, in response to one of Viasat's lead arguments—that approximately *10,000* Starlink satellites burning up in the atmosphere will disperse millions of pounds of metallic compounds that will, in turn, significantly impact the ozone layer and global warming—the Commission responded: "[W]e find that the allegations Viasat makes in its petition are insufficient for us to determine that

additional environmental consideration is necessary under our rules or that granting the SpaceX modification application may have a significant environmental impact on the atmosphere or the ozone layer." [Order.¶82]. That is the Commission's *entire* analysis of the issue—and it is plainly inadequate to permit meaningful review by this Court. Why did the Commission find Viasat's evidence insufficient? And how did the agency resolve the "disagree[ment]" it identified between the parties over the extent of the atmospheric effects? [Order.¶80]. The Order does not say.

The Commission similarly erred by repeatedly resolving uncertainty in SpaceX's favor, allowing SpaceX's unsupported, self-serving representations to negate even the *possibility* that Starlink "may have a significant environmental impact." For instance, in response to the significant evidence Environmental Appellants introduced concerning the impact of light pollution from Starlink satellites, the Commission relied heavily on SpaceX's representation "that it has diminished the average brightness of its satellites" and "made commitments to the astronomy community regarding further reduction in the visibility of its satellites." [Order.¶87]. This not only improperly treated the purported uncertainty regarding Starlink's impact on astronomy as a reason *not* to perform an environmental assessment and uncritically accepted SpaceX's characterization of a monolithic "astronomy community," but also completely ignored the *non*-astronomical

concerns in the record—such as light pollution's impact on the health and activities of humans, animals, and plants.

The Commission uncritically accepted SpaceX's unsupported assertions regarding other issues as well. The Commission dismissed The Balance Group's concerns about the lack of peer-reviewed studies assessing human radiofrequency exposure by pointing to SpaceX's averments that "it complies with the Commission's radiofrequency exposure rules." [Order.¶90 & n.376]. And the Commission rejected the environmental impact from satellite pieces falling to earth because "*SpaceX states* that its satellites will be fully demisable. In this context, that means that the calculated risk of human casualty from materials reaching the Earth's surface is roughly zero." [Order.¶84] (emphasis added). But as Viasat explained, [Viasat.Reply.at26-27], and the Commission did not dispute, SpaceX introduced *no* evidence supporting its assertion that its current satellites are fully demisable, and the evidence concerning SpaceX's prior satellites (on which the Commission relied) showed they were *not* fully demisable. *See* pp. 35-36, infra. The Commission's reliance on SpaceX's self-serving, unsupported statements to reject the possibility that the largest satellite deployment in human history "may have a significant environmental impact" is arbitrary and capricious.

## II. The Commission violated NEPA by failing to require any environmental assessment.

Correctly applied, the "may" standard is amply met here. From launch to demise, each of the thousands of Starlink satellites indisputably imposes environmental costs, from destruction of the ozone layer to light pollution to an increased risk of collisions. In each category, the only question is just how big the impact will be—and that question must be answered through an environmental assessment. Under NEPA, proceeding in ignorance of the magnitude of these harms is not an option.[6]

### A. The launch and reentry of thousands of Starlink satellites will harm the atmosphere and create dangerous debris.

#### 1. It is undisputed that deorbiting satellites will increase the level of alumina in the atmosphere, and it is undisputed that alumina is environmentally harmful.

As the Commission and SpaceX recognize, the additional satellite deployments permitted by the Commission's Order will increase the amount of both aluminum oxide, or "alumina," and soot in the atmosphere. Maintaining the Starlink constellation will require the launch and ultimate decay of thousands of

satellites. Indeed, SpaceX's business model for Starlink is to create a system of short-lived satellites that are intended to (mostly) burn up in the atmosphere as they are replaced by new, similarly expendable satellites.

Of course, when satellites combust, they do not simply vanish. SpaceX's satellites are mostly aluminum. [Viasat.Pet.Ex.15]. Putting aside pieces that may fall to Earth, *see* pp. 34-37, *infra*, when Starlink satellites burn up they produce significant quantities of alumina. *E.g.*, [Viasat.Pet.Ex.14.at177]. Researchers have predicted that the reentry of satellite constellations like SpaceX's could lead to more than 22 *million* pounds of alumina being dispersed in the atmosphere at a given time—of which Starlink will be the dominant contributor. [Viasat.Pet.Ex.15] (estimate of 10 gigagrams (Gg), which equates to 22 million pounds).

Alumina harms the atmosphere. It absorbs more radiation from Earth than it reflects from the sun, contributing to climate change through a warming of the stratosphere and upper troposphere. [Viasat.Pet.Ex14.at.193];

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[6] Faithfully applying the "may" standard is particularly important given that, since 1986, the Commission has categorically excluded *all* of its decisions from NEPA review unless the "may" standard is met (or another exception applies). Pp. 6-7, *supra.* The Commission has never considered whether that exclusion is viable in light of large-scale low-earth-orbit deployments like Starlink. *See* Note, *The Fault in Our Stars: Challenging the FCC's Treatment of Commercial Satellites as Categorically Excluded from Review Under the National Environmental Policy Act*, 22 Vand. J. Ent. & Tech. Law. 923 (2020).

[Viasat.Petition.Ex15]. Alumina also damages the ozone layer by providing a surface for chemical reactions that contribute to ozone depletion—contributing, for example, to the creation of the "infamous 'Ozone Hole'" over the Antarctic. [Viasat.Pet.Ex12.at.54, 60]. Thus, the evidence about alumina alone sufficed to establish that Starlink "may have a significant environmental impact." 47 C.F.R. § 1.1307(c).

Notably, the above evidence was essentially uncontroverted. SpaceX did not disagree that alumina harms the atmosphere or that its disintegrating satellites will increase the alumina in the atmosphere, but instead disputed the precise amount of alumina that Starlink will produce. [SpaceX.2021.04.02.Letter.at.5]. According to SpaceX, "22 million pounds of alumina in the atmosphere … is more than an order of magnitude greater" than the alumina it asserts its satellites could produce. [SpaceX.2021.04.02.Letter.at.5]. But even on SpaceX's view, therefore, its satellites will add approximately 2 *million* pounds of alumina to the atmosphere.

The Commission recognized, accurately, that "SpaceX and Viasat disagree about the amount of alumina that SpaceX's satellites could produce in the atmosphere." [Order.¶80]. The Commission nevertheless concluded—in a single sentence—"that the allegations Viasat makes in its petition are insufficient for us to determine that additional environmental consideration is necessary." [Order.¶82]. That conclusion was wrong at every turn.

*First*, any dispute over the magnitude of the environmental effect of SpaceX-produced alumina is a reason *to require* an EA. Indeed, that was this Court's precise holding in *American Bird Conservancy*. There, "[e]nvironmental groups claimed that [communication] towers kill 4 million to 50 million birds per year … while industry groups claimed that such claims [were] overstated." 516 F.3d at 1030; *compare* [SpaceX.2021.04.02.Letter.at.5] (disputing Viasat's estimates as "overwrought"). This Court admonished the agency that "'conflicting studies' and 'sharply divergent views' … confirm[], rather than refute[]" the need for environmental review. *American Bird Conservancy*, 516 F.3d at 1033-34. The probabilities and magnitude may have been contested, but "there [was] no real dispute that towers 'may' have significant environmental impact." *Id.*

Taking a charitable view of SpaceX's evidence, this case likewise involves "conflicting studies" and (somewhat) "divergent views" "about the amount of alumina that SpaceX's satellites could produce in the atmosphere." [Order.¶80]. If anything, it is clearer here than in *American Bird Conservancy* that the "may" standard has been met. In *American Bird Conservancy*, at least some evidence suggested that towers had *no* effect on bird populations. *See* 21 FCC Rcd. at 4466 ¶ 10 (noting a report finding "no studies to date that demonstrate an unambiguous relationship between avian collisions with communications towers and population decline of migratory bird species"). Here, by contrast, there is no dispute that

SpaceX's satellites will produce millions of pounds of alumina or that alumina harms the atmosphere. The evidence amply exceeds the "may" standard for an EA.

*Second*, the Commission never explained why it credited SpaceX's evidence (such as it is) over Viasat's, nor did it explain why it accepted SpaceX's analysis. SpaceX claimed that Starlink might produce only "about 0.5% the amount of alumina as the metals generated by meteorites entering the Earth's atmosphere in a given year." [SpaceX.2021.04.02.Letter.at.5]. The Commission did not rely on that particular assertion, nor could it have: SpaceX did not cite *anything* discussing the impact of satellites. The only source SpaceX cited is a chapter from a forty-year-old textbook entitled "Cosmic Dust," which it combined with a back-of-the-envelope calculation to get its 0.5% estimate. [SpaceX.2021.04.02.Letter.at.5]. By contrast, the estimate Viasat provided is based not on a self-serving extrapolation, but rather on a presentation by an independent nonprofit specifically addressing the "Environmental Impacts of Satellites." [Viasat.Petition.Ex.15]. A scientific paper published after the Commission's Order confirms the point, concluding that satellite re-entries from Starlink "alone could deposit more aluminum into Earth's upper atmosphere than what is done through meteoroids; they could thus become the dominant source of high-altitude alumina." Boley, *supra*, at 1.

Even putting that aside, SpaceX's 0.5% figure is a red herring. SpaceX maintains that it will not create more than 0.5% the amount of alumina "as *the metals* generated by meteorites." [SpaceX.2021.04.02.Letter.at.5]. SpaceX is not comparing alumina produced by its satellites to alumina produced by meteorites, but rather to *all metals* produced by meteorites. While "satellites are mostly aluminum," "most meteoroids… contain less than 1% [aluminum] by mass," Boley, *supra*, at 4, meaning that meteoroids produce only a fraction of the alumina produced by thousands of mostly aluminum Starlink satellites. Because Viasat's argument is specific to the harmful properties of alumina, SpaceX's comparison to all metals is irrelevant.

*Third,* even accepting SpaceX's assertions at face value, an environmental assessment is still required. SpaceX assumes that the increase it anticipates is effectively de minimis, but even a 0.5% increase in a substance with a documented negative effect on the environment at the very least *may* have a significant environmental effect.

2. The Commission failed to consider the potential harm from satellite debris that does *not* fully burn up in the atmosphere.

Some satellites will *not* burn up in the atmosphere. *See, e.g.*, Application for Space and Earth Station Modification, Attachment A: Technical Information to Supplement Schedule S at 46, IBFS File No. SAT-MOD-20181108-00083 (Nov. 8,

2018)[7] ("2018 Application Attachment"); *see also* [Viasat.Petition.Ex.17]. And the casualty risk from satellite debris falling from the sky is obvious. The Commission nonetheless sidestepped this issue for internally inconsistent reasons. The Commission thought that it had already "assessed the casualty risk associated with the SpaceX satellites" when it considered "technical information" SpaceX submitted in a prior modification request. [Order.¶85]. According to the Commission, (1) the old satellite design was fully demisable (*i.e.*, would fully combust), and (2) SpaceX's current satellite design was "material[ly]" the same as the old one. *Id.* The evidence in fact shows the opposite: SpaceX's old satellite design did *not* fully combust, and SpaceX attempted to correct that problem by changing some of the components in its modified satellite design—meaning the designs are *not* identical. Whether any changes were successful is anyone's guess: SpaceX presented literally no analysis substantiating its claims, and leading experts explain that SpaceX's entire "design-for-demise" "hypothesis" is untested and unproven.[8]

On the first point, concerning the old satellite design, the Commission ignored what SpaceX's "technical information" about that design actually said. Far from dismissing any casualty risk, SpaceX's own "analysis using software

[7] https://licensing.fcc.gov/myibfs/download.do?attachment_key=1569860.

purpose-built by NASA" identified "three unique components" that "may have a chance of reaching the Earth's surface with sufficient energy to result in human casualty." 2018 Application Attachment at 46. When the Commission asked SpaceX for a higher-fidelity analysis regarding those non-demisable components, SpaceX just baldly asserted its future satellite designs would not employ these components. *See* [Viasat.Petition.Ex11.at.3-5]. Thus, *the evidence the Commission itself cited* actually indicates that Starlink components could fall to Earth with lethal effect.

The Commission's premise that the old and new satellites are materially identical is wrong in any event: Nothing in the record supports the Commission's assertion (with no supporting citation) that "there is no material difference between those satellites [the prior design] and the ones under consideration here." [Order.¶85]. Indeed, the only evidence about whether the designs present the same demisability profile suggests they do not: SpaceX had told the Commission it would *change* multiple pieces of its prior design to achieve demisability. *See* p. 35, *supra*.

SpaceX did not provide a shred of evidence suggesting that the changes it made actually improved demisability. Indeed, since the Commission's Order,

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[8] P. Marks, *Dodging debris*, Aerospace America (July/August 2021), https://aerospaceamerica.aiaa.org/features/dodging-debris/.

experts have expressed significant concern that SpaceX's new design may not be fully demisable and, therefore, may pose significant threats to aircraft and people on the ground. *See* Marks, *supra*, at 13 (quoting the executive director of the International Association for Advancement of Space Safety as describing SpaceX's demisability approach as "a hypothesis; it is not a proven technology").

An environmental assessment is needed to consider the threats posed by the satellites SpaceX will actually deploy.

3. The Commission wrongly relied on an FAA assessment of rocket launches that largely ignored the effect on the upper atmosphere, including the ozone layer.

What comes down must first have gone up, but the Commission "entirely failed to consider" the environmental effects of launching thousands of satellites in the first place. *State Farm*, 463 U.S. at 43. Viasat's evidence shows that rocket launches "have a significant potential to become a significant contributor to the problem of stratospheric ozone depletion." [Viasat.Petition.Ex12.at.52].

The Commission ignored this evidence, and instead abdicated responsibility to the Federal Aviation Administration ("FAA"), which had previously prepared "its own EA on the SpaceX launches" and concluded that "no additional consideration of potential impacts associated with those launches [wa]s required." [Order.¶82]. But the FAA's assessment was limited: It studied air quality only *below 3,000 feet*, and its climate-related analysis focused on greenhouse-gas

emissions. *E.g.*, FAA, *Final Environmental Assessment and Finding of No Significant Impact for SpaceX Falcon Launches at Kennedy Space Center and Cape Canaveral Air Force Station* 33, 37-39 (July 2020).[9] The FAA in fact recognized that "emissions from operations at or above 3,000 feet … *would occur*"—they just "would not result in appreciable *ground-level* concentrations." *Id.* at 33 (emphases added). And the FAA recognized, in passing, that Starlink launches release ozone-depleting substances directly into the stratosphere, *id.* at 71, but completely ignored the "unique" threat posed by even "small absolute amounts" of these substances, which are "the only human-produced source of ozone-destroying compounds injected directly into" the ozone layer, [Viasat.Pet.Ex.12.at.52]. The Commission cannot pass the buck to the FAA when the FAA ignored the most important question: how the launches' injection of harmful compounds *directly into the ozone layer* affects ozone depletion or atmospheric chemistry more broadly. *See* [Viasat.Petition.Ex12.at.52].

Decisionmaking that ignores an "important aspect of the problem" is exactly what the APA forbids. *State Farm*, 463 U.S. at 43. Under NEPA, before the Commission could declare the process over, it was required to "carefully review[]" the record and "ma[k]e a reasoned decision" about the significance of the

[9] https://www.faa.gov/space/environmental/nepa_docs/media/SpaceX_Falcon_Program_Final_EA_and_FONSI.pdf

information FAA never considered. *Marsh v. Or. Nat. Res. Council*, 490 U.S. 360, 378 (1989). It did no such thing.

### B. Starlink will create unprecedented light pollution that alters the night sky.

Environmental Appellants provided extensive evidence demonstrating that deploying thousands of Starlink satellites has already significantly altered the night sky—both by increasing skyglow and by adding thousands of light-reflecting objects that will be visible from Earth.[10] As the number of Starlink satellites in low-earth orbit grows, so does the amount of light pollution, which Starlink will increase to unprecedented and harmful levels. *See, e.g.*, [Viasat.Petition.Ex.18]; [Viasat.Petition.Ex.19]; [Viasat.Petition.Ex.24].

Starlink threatens to "severely harm ground based astronomical observations." [Viasat.Petition.Ex.24.at.1]; *see also* [Viasat.Reply.Ex.13.at.28-31, 137-145]. The record evidence—principally from professional astronomers—shows that a satellite constellation like Starlink will have "significant negative [astronomical] impacts" and "increase significantly" background "skyglow," making it difficult both to observe and to take photographs. *See* [Viasat.Petition.Ex.19.at3]; *see also* [Viasat.2021.04.16.Letter.at.5-6].

[10] *See, e.g.*, M. Kocifaj et al., *The Proliferation of Space Objects Is a Rapidly Increasing Source of Artificial Night Sky Brightness* at L41, Monthly Notices of the Royal Astronomical Society (Mar. 29, 2021) (discussed at

Professional astronomer Dr. Andy Lawrence, for instance, warned that Starlink satellites pose a "[t]hreat to astronomical science" and "regularly 'photobomb[]' observations from both the ground and from space." [Lawrence.2021.04.21.Letter.at1]; *see also* [Viasat.Pet.Ex.18]; [Viasat.Petition.Ex.19]. And a report by The Aerospace Corporation, a nonprofit dedicated to advising the government on space enterprise, explained that Starlink and other constellations could "have a negative impact on astronomical research, undercutting investments made in astronomy by national governments, universities, and private foundations around the world." [Viasat.Pet.Ex.18.at.2]; *see also* [Viasat.Reply.Ex.13.at.15].[11]

Increased skyglow from Starlink satellites has impacts beyond astronomy and stargazing. Artificial objects *currently* in orbit have increased skyglow by ten percent, and "[t]his effect will certainly be aggravated by the planned deployment of huge satellite 'mega-constellations' that will add a substantial number of reflecting objects" and "increase significantly this light pollution source." Kocifaj, *supra*, at L43, L45 (discussed at [Viasat.2021.04.16.Letter.at.5]).

As a host of studies show, light pollution has negative impacts on human health (including sleep disruption and eye disorders), [Viasat.Pet.Exs.21-24];

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[Viasat.2021.04.16.Letter.at5]), *available at* https://academic.oup.com/mnrasl/article/504/1/L40/6188393.

[Viasat.Reply.Ex.13.at.14-16, 92-102], and on flora and fauna, [Viasat.Reply.Ex.13.at.28] (noting impact on "animal and insect life" from satellite constellations in low-earth orbit); [Viasat.Reply.Ex.13.at.102-109]; National Park Service, *Night Skies as a Natural Resource*[12] (discussed at [Balance.Group.Opposition(Corrected).at.13-14]). For example, some animals have been shown to "navigate and migrate using the stars at night"—activity that is hindered by artificial nighttime light. [Viasat.Reply.Ex.13.at.102] (citing J. Foster et al., *How animals follow the stars*, Proceedings of the Royal Society B (2018)[13]). Recent studies show that increased nighttime light, including "at levels far less intense than previously assumed[,] are able to entrain circadian rhythms and influence physiological functions such [as] immune response" in mammals. [Viasat.Reply.Ex.13.at.107]. And increased nighttime light can have a significant impact on predator-prey relationships by, for instance, "increas[ing] success of visually foraging predators, thereby increasing risk to their prey." [Viasat.Reply.Ex13.at.105]. Studies also show that trees and other plants can be harmed by increased exposure to nighttime light, which can impact their reproductive patterns and decrease their ability to fight infections. [Viasat.Reply.Ex.13.at.107-108]. In sum, the "impact of … skyglow is … a major

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[12] https://www.nps.gov/subjects/nightskies/natural.htm.

factor in the decline of habitat for nocturnal wildlife, reducing ecological functions and reproduction, and consequently leading to a loss of biodiversity as sensitive organisms experience decreasing food sources and habitat." [Viasat.Reply.Ex.13.at108].

The Commission *acknowledged* these environmental impacts, but brushed them aside by pointing to SpaceX's purported mitigation attempts. Specifically, the Commission accepted SpaceX's "representation[s]" that it had "diminished the average brightness of its satellites" and "made commitments to the astronomy community regarding further reduction in the visibility of its satellites." [Order.¶87]. But mitigation obviates the "need for additional review" only if the post-mitigation impact "is not significant"—in other words, if it is no longer the case that the agency's action may have a significant environmental effect. *Cabinet Mountain Wilderness v. Peterson*, 685 F.2d 678, 682 (D.C. Cir. 1982); *see also Sierra Club v. Marsh*, 769 F.2d 868, 877 (1st Cir. 1985) (Breyer, J.). Otherwise anyone could avoid NEPA review simply by promising to do *some* mitigation.

Here, the Commission never made a finding that the light pollution Starlink produces will not have a significant effect post-mitigation. In fact, the evidence shows the opposite. *See* [SpaceX.2021.04.02.Letter.at5] (SpaceX acknowledging to the Commission that "there is more work to do … to reduce the impact of

[13] https://royalsocietypublishing.org/doi/10.1098/rspb.2017.2322

satellite brightness"). The United Nations Office for Outer Space Affairs has recognized that, "[e]ven if all mitigations [being discussed] were implemented, astronomy will pay dearly." [Viasat.Reply.Ex.13.at.150]. Given the sensitivity of astronomical instruments, for many measurements "there is no mitigation beyond identifying which [astronomical] data to throw out." [Viasat.Reply.Ex.13.at148]. Thus, regardless of the measures SpaceX takes, "[a]ll observatories planet-wide will be affected," and the "upcoming contamination will degrade the legacy" of the "data archives" of "each and every observatory." *Id.*; *see also* [Viasat.Pet.Ex.24.at.8-9] (explaining that, even with SpaceX's mitigation, "degradation for scientific observations will remain high"); [Viasat.Reply.Ex.13.at247] ("none of [SpaceX's mitigation] strategies so far are yet achieving" recommended brightness levels). Nor will mitigation obviate the impact for everyday stargazers.

The Order accepted SpaceX's assertion that it dimmed its satellites "from a 4.99 apparent magnitude to a 6.48 apparent magnitude" (lower magnitudes are brighter), but never identified record support for this claim.[14] [Order.¶86.n.351];

[14] One of SpaceX's proposed modifications may *increase* light pollution when the satellites are in certain positions in orbit. [Viasat.Reply.Ex.13.at142]. Another potential modification—painting satellites black—could lead satellites to accumulate heat, impacting astronomical observation and damaging satellite electronics and function, thus risking higher satellite failure rates. *See* [Viasat.2021.04.16.Letter.at.5].

[Order.¶87]. To the contrary, contradicting its representation to the agency, SpaceX's own website states: "Starlink satellites have an average apparent magnitude of 5.5 when on-station and brighter during orbit raise."[15] Moreover, even taking SpaceX's assertion at face value, SpaceX concedes that magnitude 6.48 objects remain "visible to the naked eye."[16] The Commission also improperly credited SpaceX for mitigating the effect of its satellites by lowering their altitude, thereby (according to SpaceX) reducing their apparent brightness.[17] [Order.¶86]. As the Commission itself explained earlier in the Order, because SpaceX never received full authorization for these 2,824 satellites at any altitude, the proper baseline for comparison is no satellites at all—not satellites at a higher altitude. [Order.¶54]; *see also Gen. Chem. Corp. v. United States*, 817 F.2d 844, 846 (D.C. Cir. 1987) (holding agency action arbitrary and capricious when based on analysis that was "internally inconsistent and inadequately explained"). Regardless of the baseline, Starlink will indisputably change the sky when, even post-mitigation, its satellites are plainly visible:

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[15] *See* SpaceX, *Astronomy Discussion with National Academy of Sciences* (Apr. 28, 2020), *available at* https://www.spacex.com/updates/starlink-update-04-28-2020/.

[16] *Id.*

[17] Lowering the altitude of satellites does not necessarily mitigate their effect. Starlink satellites appear brighter at lower altitudes because they are closer. [Viasat.Pet.Ex.18.at.3]; [Viasat.Reply.Ex.13.at.134]. That increased brightness occurs during astronomical and nautical twilight—a key time for astronomical observations. [Viasat.Petition.Ex.19.at5].

Figure 5.11. Starlink-1436 (Visorsat) as imaged by the Zeiss 1.23m telescope at Calar Alto, Spain on 20 September 2020. Visorsat (at 555 km orbital height) is the trail seen in the bottom left. A second trail from in the upper middle corresponds to Starlink-1348 (at 386 km orbital height).

[Viasat.Reply.Ex13.at242].

The Commission committed to monitor the situation—a tacit acknowledgment of the potential for significant risk, particularly when coupled with its encouragement to SpaceX to further reduce astronomical impact, [Order.¶87]. It also conceded that SpaceX was "still testing some of [its purported] solutions," which presumably means that SpaceX is currently deploying satellites without them. *Id.* The Commission's decision to nevertheless decline even an initial review—despite recognizing a light-pollution problem for SpaceX to further "mitigate" and the Commission to "monitor"—cannot be reconciled with NEPA's directive to agencies to "look first, and then leap." *Laclede Gas Co. v. FERC*, 873 F.2d 1494, 1499 (D.C. Cir. 1989).

### C. Starlink will increase the amount of pollution in space.

The Commission has repeatedly catalogued the dangers of orbital debris and collisions. It recently warned that at least some analysts believe certain orbits "are close to or have already reached a 'runaway' status," whereby the "collision hazard in the orbital region [] may be too high for most space operations." *Orbital Debris*, 35 FCC Rcd. at ¶4 & n.6. And it has likewise noted that "orbital debris poses a potential risk to the continued reliable use of these orbital regimes for space-based services and operations, as well as to the continued safety of persons and property in space and on the surface of the Earth." *Orbital Debris*, 19 FCC Rcd. 11,567, 11,570 (2004). It described why "[t]he effects of collisions involving orbital debris can be severe," explaining that a collision with an object as small as one centimeter in diameter could cause damage to a functional spacecraft that "can be catastrophic." And it highlighted that "such collisions can produce a large amount of additional debris, which can be dispersed over a wide orbital area," causing a cascade of yet more catastrophic collisions. *Id.* In fact, the Commission is currently updating its orbital-debris rules to determine what limits on collision risk are necessary for large satellite constellations "from the perspective of sustaining the space environment." *Orbital Debris*, 35 FCC Rcd. ¶155.

The collision risk here is undisputed. A substantial number of SpaceX's satellites will fail during its license term—the Commission predicted potentially

hundreds. [Order.¶¶61-63]. Indeed, many already have. [Mehlman.Letter.Jan.15.2021.at.4-5]. When they fail and lose the ability to avoid collisions, they create "a collision risk for as long as they remain on orbit." [Order.¶63]. And SpaceX is launching its thousands of satellites into an already very crowded part of space. [Viasat.Reply.at.37]. The Commission acknowledged these findings, explaining that SpaceX satellites pose a collision risk of anywhere between 1-in-200 and 1-in-44.5 over the license term, depending on the number of satellites launched and the precise failure rate. [Order.¶¶61-63]. The Commission thus concluded that the collision risk from failed satellites requires "continued monitoring." [Order.¶ 64].[18] The Commission came to the same conclusion with respect to operational satellites, and therefore conditioned approval of the Application on SpaceX's semi-annual reporting of several risk indicators. [Order.¶58].

[18] In addition to its environmental impact, an increase in space pollution poses a threat to national security given the government's reliance on satellites, including in low-earth orbit. *E.g.*, [Viasat.Pet.Ex.18.at1-2]; [Viasat.Petition.Ex.25]; *see also* Add10. That threat is enhanced by the disproportionate dangers posed by a cyberattack to a system like Starlink. [Balance.Group.Opposition(Corrected).at.4, 6, 10, 24]. The Commission also failed to address the environmental impact, including remediation efforts, from a catastrophic failure, especially regarding SpaceX's apparent lack of insurance against such a failure. [Balance.Group.Opposition(Corrected).at.3-4, 17, 23].

The Commission in fact did not dispute that it had to require *some* review of space pollution, but appeared to suggest that an informal analysis through its existing (but still evolving) orbital-debris regime should suffice. [Order.¶ 56]. That analysis, however, is incomplete. The Commission deemed the precise level of risk to be "a matter of significant contention in the record," but it never resolved the dispute, or even identified what level of risk would be acceptable. [Order.¶¶58, 61, 63-64]. Moreover, while the Order elsewhere warned of the dangers of orbital debris, the Commission never actually grappled with the results of a collision. *See New York v. NRC*, 681 F.3d 471, 482 (D.C. Cir. 2012) (agency "must examine both the probability of a given harm occurring *and* the consequences of that harm if it does occur") (emphasis added). The Commission's decision not to require further environmental review cannot be squared with the substantial gaps in its knowledge, particularly its lack of clarity regarding how severe a collision risk Starlink actually poses.

In sum, the Commission has repeatedly engaged with the dangers of orbital debris, and here specifically recognized there was a dispute in the record over the precise collision risk and determined the risk was significant enough to warrant continued monitoring and reporting. Despite all of that, the Commission *still* decided that NEPA did not require any environmental review—again in a single conclusory sentence. [Order.¶89] ("Viasat's arguments about these issues have

failed to set forth in detail reasons justifying or circumstances necessitating environmental consideration of these issues under section 1.1307(c) of our rules."). The Commission failed to explain how the risks of collisions and the creation of orbital debris were serious enough to require "continued monitoring," yet simultaneously so inconsequential that even the modest review of an environmental assessment is unnecessary. [Order.¶64]. The Commission cannot hide behind its existing orbital-debris regulation to suggest it satisfied NEPA—particularly because the Commission acknowledges those regulations need to be updated, *see Orbital Debris*, 35 FCC Rcd. ¶¶154-168, and it has been examining for almost three years what limits are necessary to safely constrain the collision risks posed by a large low-earth orbit constellation (such as Starlink) in its entirety, *see id.*; *see also Mitigation of Orbital Debris in the New Space Age*, 33 FCC Rcd. 11352 (2018). Without resolving that question, it has no basis for rejecting Environmental Appellants' argument that the Order "may have a significant environmental impact." 47 C.F.R. § 1.1307(c).

* * *

The Commission's Order makes clear its intent to play ostrich and hope that SpaceX's deployment of thousands of satellites will not harm the environment—despite reams of evidence to the contrary. That approach runs directly counter to NEPA's directive to agencies to pause and evaluate potential risks before acting,

rather than heedlessly downplaying "any and all discussion of future environmental effects as 'crystal ball inquiry.'" *Scientists' Institute for Public Information v. AEC*, 481 F.2d 1079, 1092 (D.C. Cir. 1973). If ever there were a situation where an initial environmental assessment is appropriate, it is here, before the agency allows SpaceX to implement its unprecedented and largely irreparable takeover of low-earth orbit.

## III. Environmental Appellants are within NEPA's zone of interests.

Both Environmental Appellants are proper parties to point out these errors in the Order, because both are within NEPA's zone of interests. The zone-of-interests inquiry is "not meant to be especially demanding": A party fails only if its "interests are so marginally related to or inconsistent with the purposes implicit in the statute that" Congress could not have meant to authorize the suit. *Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians v. Patchak*, 567 U.S. 209, 225 (2012). The relevant question is "whether the challenger's interests are such that they in practice can be expected to police the interests that the statute protects." *Amgen, Inc. v. Smith*, 357 F.3d 103, 109 (D.C. Cir. 2004) (citation omitted).

NEPA's zone of interests "encompasses environmental values, read, of course, very broadly." *Gunpowder Riverkeeper v. FERC*, 807 F.3d 267, 274 (D.C. Cir. 2015) (quoting *Realty Income Trust v. Eckerd*, 564 F.2d 447, 453 n.11 (D.C. Cir. 1977)). NEPA includes broad declarations of "purpose" and "policy," which

demonstrate a goal of achieving a responsible, efficient, and productive use of environmental resources. The declaration of purpose, for instance, states that NEPA's purposes are:

> To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; [and] to enrich the understanding of the ecological systems and natural resources important to the Nation[.]

42 U.S.C. § 4321. NEPA's statement of policy similarly emphasizes NEPA's broad values, encompassing, among other things, ensuring efficient use of the natural environment to "fulfill the social, economic, and other requirements of present and future generations of Americans." *Id.* § 4331; *see also* 40 C.F.R. § 1508.1(g) (statute's reach extends to a wide range of "effects," including "economic" ones). Both Environmental Appellants easily fall within NEPA's capacious zone.[19]

### A. The Balance Group

As discussed, pp. 16-17, *supra*, The Balance Group's mission includes protecting humans, flora, fauna and the environment from preventable harms caused by technological advances. Add37-38. The Balance Group's numerous objections raised to SpaceX's Major Modification request, and the myriad

environmental considerations and concerns underlying them, are aimed squarely at encouraging that SpaceX's Starlink system be allowed only to the extent it "encourage[s] productive and enjoyable harmony between man and his environment," and to "prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man." 42 U.S.C. § 4321. Its interests are squarely within the zone NEPA protects.

So too are the united interests of its many members—astronomers, physicists, scientists, environmental organizations, technologists, and health-care workers and patients—as exemplified by Dr. Baddiley and Dr. Malina. As astrophysicists whose research has been (and will continue to be) negatively impacted by light pollution from SpaceX's Starlink system, they fall squarely within NEPA's zone of interests. *See Monsanto Co. v. Geertson Seed Farms*, 561 U.S. 139, 155-156 (2010) (alfalfa farmers and environmental groups fell within NEPA's zone of interests for purposes of challenging agency's deregulation of herbicide without requiring an EIS).

**B. Viasat**

Viasat, too, asserts "interests that the statute protects." *Amgen*, 357 F.3d at 109. Viasat has an interest in preserving the shared orbital environment and

[19] Just as only one party need have standing, only one party need fall within the zone of interests. *See Nat'l Ass'n of Home Builders v. U.S. Army Corps of Eng'rs*, 417 F.3d 1272, 1288 (D.C. Cir. 2005).

ensuring that reckless uses of that environment undergo appropriate scrutiny. Indeed, as Viasat explained to the Commission, it has dedicated significant resources to developing its own global low-earth orbit system, and it will soon be expanding its fleet with additional satellites. Add8-11. For example, each of Viasat's ViaSat-3 satellites, which the company has spent years and over $1 billion bringing to life, will be the highest-capacity communications satellite ever launched. Add10-11. Viasat's interests in the safe and efficient use of a shared natural resource thus closely align with NEPA's goal of ensuring adequate consideration of "the profound impact of man's activity on the interrelations of all components of the natural environment." 42 U.S.C. § 4331(a).

Viasat's parallel commercial interests do not preclude its NEPA challenge. The test is not whether the appellant's "'real' or 'obvious' interest may be viewed as monetary." *Nat'l Ass'n of Home Builders*, 417 F.3d at 1287 (citation omitted).. Rather, "[p]arties motivated by purely commercial interests routinely satisfy the zone of interests test" when, given its specific commercial interests, the party "can be expected to police the interests the statute protects." *Amgen*, 357 F.3d at 109 (citation omitted). This Court has thus squarely held that "commercial entities are not *per se* excluded from NEPA's zone-of-interest." *National Association of Home Builders*, 417 F.3d at 1287. Barring commercial parties "from asserting cognizable injury to environmental values" would "not square with the broad

Congressional purpose in NEPA of ensuring that environmental values would be adequately and pervasively considered in federal decisionmaking." *Id.* (citation omitted).

## CONCLUSION

The Court should vacate the Commission's approval of SpaceX's Application, hold that NEPA requires at least an environmental assessment, and remand for proceedings compliant with NEPA.

Dated: August 6, 2021

Respectfully submitted,

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## CERTIFICATE OF COMPLIANCE

This brief complies with the type-volume limitation of Federal Rule of Appellate Procedure 32(a)(7) and this Court's July 20, 2021 order as it contains 10,992 words, excluding the parts of the brief exempted by Federal Rule of Appellate Procedure 32(f) and D.C. Circuit Rule 32(e)(1).

This brief complies with the typeface requirements of Federal Rule of Appellate Procedure 32(a)(5) and the type style requirements of Federal Rule of Appellate Procedure 32(a)(6), as it has been prepared in a proportionally spaced typeface, 14-point Times New Roman font, using Microsoft Word 2010.

Dated: August 6, 2021

/s/ *William M. Jay*
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**CERTIFICATE OF SERVICE**

I hereby certify that on August 6, 2021 I electronically filed the foregoing document with the United States Court of Appeals for the D.C. Circuit by using the CM/ECF system. I certify that the counsel of record for Appellee and Movant-Intervenor are registered as ECF Filers and that they will be served by the CM/ECF system.

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