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January 12, 2022

VIA ELS

Marlene H. Dortch
Secretary
Federal Communications Commission
45 L Street, NE
Washington, DC 20554

Re: General Atomics
Response to FCC Questions, Ref No. 66480 (dated Dec. 20, 2021)
ELS File No. 1064-EX-CN-2020

Dear Ms. Dortch:

General Atomics supplements its pending application and provides the attached response to the email inquiries from the Federal Communications Commission.[1]

Please feel free to contact the undersigned if you have any questions.

Very truly yours,

/s/Tony Lin

Tony Lin
Counsel to General Atomics

Attachment

[1] *See* Email from Anthony Serafini, FCC, to Victor Gomez, General Atomics (Dec. 20, 2021).

General Atomics Responses to FCC Inquiries Regarding OTB-3 Mission

January 12, 2022

Provided below are responses to the FCC's email inquiries in the 1064-EX-CN-2020 application proceeding.[1] The FCC questions are reproduced below in bold.

1. **Noting that the currently specified mission altitude of 750km was described in GA's response of 6/2/2021 as chosen due to a specification in the mission contract, please indicate whether that contract was executed subject to any necessary regulatory approvals.**

   General Atomics is generally obligated under the Hosted Payload Services contract with the U.S. Air Force Space and Missile Systems Center to ensure that the OTB-3 satellite complies with all applicable laws and requirements. See also the response to Question 4 below.

2. **Please indicate whether, to your knowledge, the spacecraft or any of its component parts has been the subject of a customer-conducted safety or orbital debris mitigation review, and if so, please indicate who conducted the review, and the nature and scope of that review.**

   General Atomics is not aware that the customer conducted a safety or orbital debris mitigation review of the spacecraft or any of its component parts. However, as stated below in the response to Question 3 (and previously in the June 2, 2021 response), General Atomics has conducted such an analysis and the results show that OTB-3 complies with NASA and FCC requirements.

3. **Please state whether the design for demise measures described in your response of 6/2/21 are inclusive of all subcomponents analyzed for re-entry casualty risk, noting in particular the items identified as the ARGOS TXU and RPU, which we assume correspond to the NOAA/CNES-supplied UHF/L-band radio. Please indicate which particular components were considered as ones with "high kinetic energy" and were "conservatively modelled" and identify with specificity the particular modelling methods involved. To the extent a higher fidelity method can support the assertion that some or all of these components may demise upon re-entry, please provide an analysis utilizing that method.**

   The design-for-demise approaches with respect to OTB-3 apply to all those components for which General Atomics is responsible for manufacturing and does not include the ARGOS-4 payload, which was provided by the French Centre National d'Etudes Spatiales (CNES), one of the international signatories to the ARGOS program. The ARGOS TXU and RPU correspond to the NOAA/CNES-supplied UHF/L-band radio.

   The objects with "high kinetic energy" that were "conservatively modelled," as stated in the application narrative (at p. 27), refer to the ARGOS TXU and RPU. The analysis was done using the NASA DAS software to assess compliance with NASA Requirement 4.7-1, limiting the risk of human casualty to less than 0.0001 (1:10,000). All objects were input with their quantity, material, body type, thermal mass, dimensions and kinetic energy into the DAS software. The

[1] *See* Email from Anthony Serafini, FCC, to Victor Gomez, General Atomics (Dec. 20, 2021).

modelling is conservative because NASA DAS assumes there is no pre-heating of the internal objects, as stated in the application (at p. 27). Properly considering pre-heating could result in the determination of break-up of internal components of the ARGOS TXU and RPU.

At the FCC's suggestion, General Atomics has conducted a higher fidelity analysis of the re-entry casualty risk by breaking down the RPU and TXU units into their respective subcomponents, based on information provided by CNES. The RPU was broken down into 6 subcomponents: DC converter, SEG, SET1, SET2, SER Rx and SER RF Comm. The TXU was broken down into 3 subcomponents: Connector RF switch, TX1 and TX2. The NASA DAS software analysis, summarized below, shows that all components burn up during re-entry. Accordingly, the analysis below demonstrates that OTB-3 satisfies NASA Requirement 4.7-1.

A revised Table 7, identifying the major components of the spacecraft, is provided below. For the FCC's convenience, General Atomics has highlighted the cells containing revised or new data.

Revised Table 7:

No	Name	Qty	Material	Body Type	Mass [kg]	Diameter or Width [m]	Length [m]	Height [m]	Demise Alt [km]	DCA [m^2]	KE [J]
1	**OTB-3**	1	Aluminum (generic)	Box	120	0.574	0.859	0.574		0	
2	**MLB**	1	Aluminum (generic)	Box	2.76	0.381	0.381	0.053	71.5		
3	**Avionics Bay**	1	Aluminum (generic)	Box	2.078	0.515	0.555	0.3	76.7		
4	Harness	1	Copper Alloy	Flat Plate	7.15	0.2	0.4		62.1		
5	Magnetorquers	3	Aluminum (generic)	Box	0.5	0.2	0.2	0.2	75.4		
6	10SP Reaction Wheel	3	Aluminum (generic)	Cylinder	1	0.104	0.102		69		
7	Battery	1	Aluminum (generic)	Box	4.4	0.159	0.221	0.068	61		
8	Avionics Bay Fasteners	1	Aluminum (generic)	Box	4	0.2	0.2	0.2	66.8		
9	**Avionics Stack**	1	Aluminum (generic)	Box	2.4	0.515	0.547	0.288	75.1		
10	PIU Tray	1	Aluminum (generic)	Box	0.6	0.294	0.322	0.033	73		
11	PIU Board	2	Fiberglass	Flat Plate	0.7	0.286	0.314		73.4		
12	AIM Tray	1	Aluminum (generic)	Box	0.6	0.294	0.322	0.033	73		
13	AIM Board	2	Fiberglass	Flat Plate	0.7	0.286	0.314		73.4		
14	ASM Tray	1	Aluminum (generic)	Box	0.6	0.294	0.322	0.033	73		
15	ASM Board	2	Fiberglass	Flat Plate	0.7	0.286	0.314		73.4		
16	S-Band Tx/Rx Tray	1	Aluminum (generic)	Box	0.6	0.294	0.322	0.033	73		
17	S-Band Tx/Rx Board	2	Fiberglass	Flat Plate	0.7	0.286	0.314		73.4		
18	OBC 750 Tray	1	Aluminum (generic)	Box	0.6	0.294	0.322	0.033	73		

No	Name	Qty	Material	Body Type	Mass [kg]	Diameter or Width [m]	Length [m]	Height [m]	Demise Alt [km]	DCA [m²]	KE [J]
19	OBC 750 Board	2	Fiberglass	Flat Plate	0.7	0.286	0.314		73.4		
20	PDM Tray	1	Aluminum (generic)	Box	0.6	0.294	0.322	0.033	73		
21	PDM Board	1	Fiberglass	Flat Plate	1.2	0.286	0.314		72.2		
22	BCM Tray	1	Aluminum (generic)	Box	0.6	0.294	0.322	0.033	73		
23	BCM Board	1	Fiberglass	Flat Plate	1.7	0.286	0.314		71		
24	Tie Rods	8	Titanium (6 Al-4 V)	Cylinder	0.066	0.008	0.3		71.4		
25	**Lower Payload Bay**	1	Aluminum (generic)	Box	8.489	0.547	0.547	0.4	73		
26	Argos RPU	1	Aluminum (generic)	Box	3	0.304	0.305	0.2	68.1	0	0
27	DC Converter	1	Fiberglass	Box	1.895	0.2	0.304	0.051	62.3	0	0
28	SEG	1	Fiberglass	Box	1.895	0.2	0.304	0.051	62.3	0	0
29	SET1	1	Fiberglass	Box	1.895	0.2	0.304	0.051	62.3	0	0
30	SET2	1	Fiberglass	Box	1.895	0.2	0.304	0.051	62.3	0	0
31	SER RX	1	Fiberglass	Box	1.895	0.2	0.304	0.051	62.3	0	0
32	SER RF Comm	1	Fiberglass	Box	1.895	0.2	0.304	0.051	62.3	0	0
33	HDRM	2	Aluminum (generic)	Cylinder	0.66	0.12	0.093		67.7		
34	Magnetometers	2	Aluminum (generic)	Box	0.215	0.061	0.099	0.05	70.4		
35	Lower Payload Bay Fasteners	1	Aluminum (generic)	Box	2	0.1	0.1	0.1	57.3		
36	**Upper Payload Bay**	1	Aluminum (generic)	Box	8.153	0.547	0.58	0.2	71.9		
37	L-Band Transmitter	2	Aluminum (generic)	Cylinder	1.9	0.06	0.25		60.7		
38	Filter	1	Aluminum (generic)	Box	0.4	0.068	0.1	0.063	67.6		
39	Switch	1	Aluminum (generic)	Box	0.1	0.068	0.1	0.063	70.9		
40	Diplexer	1	Aluminum (generic)	Box	0.985	0.127	0.1524	0.0508	63.8		
41	Argos TXU	1	Aluminum (generic)	Box	1.5	0.284	0.31	0.121	68.8	0	0
42	Connector RF Switch	1	Fiberglass	Box	2.43	0.121	0.31	0.095	63.1	0	0
43	TX1	1	Fiberglass	Box	2.43	0.121	0.31	0.095	63.1	0	0
44	TX2	1	Fiberglass	Box	2.43	0.121	0.31	0.095	63.1	0	0
45	Upper Payload Bay Fasteners	1	Aluminum (generic)	Box	2	0.1	0.1	0.1	55.6		
46	**Argos UHF Antenna**	1	Aluminum (generic)	Cylinder	2.8	0.136	0.681		73.7		
47	**S-Band Patch Antennas**	6	Aluminum (generic)	Box	0.08	0.082	0.082	0.067	77.1		
48	**Monopole Antenna**	4	Aluminum (generic)	Cylinder	0.06	0.06	0.15		77.4		
49	**Argos L-Band Antenna**	1	Aluminum (generic)	Cylinder	0.29	0.057	0.263		76.1		
50	**Radiator Panels**	2	Aluminum (generic)	Flat Plate	1.9	0.58	0.7		75.2		

No	Name	Qty	Material	Body Type	Mass [kg]	Diameter or Width [m]	Length [m]	Height [m]	Demise Alt [km]	DCA [m²]	KE [J]
51	**Deployed Solar Panel**	2	Aluminum (generic)	Flat Plate	2.9	0.58	0.934		74.6		
52	**Body Solar Panel**	2	Aluminum (generic)	Flat Plate	2.02	0.55	0.55		74.1		
53	**Deorbit Sail**	1	Polyamide	Flat Plate	2.8	0.45	2.8		77.7		
54	**Sun Sensors**	2	Aluminum (generic)	Box	0.35	0.15	0.15	0.15	76.6		
55	**Sun Sensor Bracket**	1	Aluminum (generic)	Box	0.28	0.15	0.15	0.15	76.9		
56	**External Fasteners**	1	Aluminum (generic)	Box	6	0.2	0.2	0.2	64.1		

4. **Please indicate whether the program of experimentation, which appears to be focused on correlation of measurements with communications link performance, would meet its technical objectives at a lower altitude.**

   The RADMON payload can fulfill its mission at a variety of orbital altitudes, including altitudes lower than 750 km. The RADMON payload provides measured data on the long-term radiation environment experienced in the LEO environment and correlates the radiation activity with on-board electronics performance. The RADMON payload measurements are not connected with communications link performance, as stated in the FCC question.

   Ideally, the RADMON payload would operate in an altitude between 650-750 km to simulate the impact of radiation to spacecraft components in typical LEO orbital altitudes and to ensure that the proximity to the inner Van Allen Belt (~1000 km) does not limit the duration of the experiment.

   The ARGOS-4 payload has a 650 to 900 km mission operating range. Higher altitudes allow for greater data collection capabilities. The parties negotiated 750 km as the agreed upon target orbital altitude for the launch, as a compromise of the different OTB-3 hosted payloads (i.e., RADMON and ARGOS-4), the commercial economics of the selected launch vehicle, and the capabilities of the launch service that General Atomics procured.

5. **Please provide an update on whether the drag sail model utilized on STPSAT-3, as noted in your 6/2/2021 response concerning flight heritage, has been deployed.**

   Public information regarding STPSAT-3 indicates that the satellite is still operational, and the drag sail has not been deployed. General Atomics has no additional information regarding STPSAT-3.

6. **Noting that the application includes a statement that the "[r]equest for S-Band spectrum is consistent with federal Space Operations usage for the OTB-3 satellite telemetry, Hosted Payload telemetry, and RADMON experimental data download" and that the satellite has been described in some official documents as a "Federal" satellite, please address why the satellite should not be considered a station "belonging to and operated by..." the Federal government, and therefore not subject to FCC licensing.**

The quoted text in the question above is contained in Note 5 to Table 3 of the application and provides the rationale for OTB-3's use of the 2200-2290 MHz frequency band. That band is allocated internationally for Space Operations but in the United States is limited to federal Space Operations. The text in Note 5 explains that the proposed uses of the band (also identified in Table 6 of the application) – *i.e.*, satellite telemetry, tracking, and commanding (TT&C) and telemetry associated with the hosted payload - are consistent with the U.S. federal Space Operations allocation. Similarly, the use of the 2200-2290 MHz band for RADMON data downlink is consistent with the U.S. federal Space Research allocation.

The text in Note 5 does not state that OTB-3 is a federal satellite operating in compliance with U.S. federal frequency allocations. Similarly, the text does not ask the FCC to treat OTB-3 as a federal satellite. Indeed, the application makes clear that OTB-3 is owned and operated by General Atomics and that ARGOS-4 is a hosted payload onboard OTB-3. *See, e.g.*, Narrative, ELS File No. 1064-EX-CN-2020, at 3 (filed Dec. 24, 2020). General Atomics is not aware of any such "official" company documents referring to OTB-3 as a Federal satellite. In any event, any such documents would be inaccurate, as explained above.

Moreover, use of federal spectrum by commercial operators is permitted subject to coordination with affected federal operators. *See, e.g.*, Application of Loft Orbital Solutions Inc., IBFS File No. SAT-LOA-20190807-00072 (granted Oct. 8, 2020) (granting authority to use a single 2 MHz channel in the 2200-2290 MHz band to communicate with non-U.S. ground stations coordinated with NTIA); Application of R2 Space, LLC, IBFS File No. SAT-LOA-20200511-00042 (granted Dec. 18, 2020) (granting authority to use a single 1.5 MHz channel in the 2200-2290 MHz band to communicate with non-U.S. ground stations coordinated with NTIA); Application of The Aerospace Corporation, ELS File No. 0583-EX-CN-2020 (granted Feb. 10, 2021 (granting authority to use two channels in the 2200-2290 MHz band: a single 4.91 MHz channel to communicate with a ground station located in Vandenberg, California and a single 4 MHz channel to communicate with ground stations located in Puertollano, Spain and Hartebeesthoek, South Africa); Application of Tyvak Nano-Satellite Systems, ELS File No. 0987-EX-CN-2018 (granted Apr. 27, 2020) (granting authority to use a single 2.8 MHz channel in the 2200-2290 MHz band to communicate with a ground station located in Svalbard, Norway); Application of General Atomics, ELS File No. 0457-EX-CR-2021 (granted Aug. 6, 2021) (renewing ELS File No. 0050-EX-CM-2019 and granting authority to use a single 3.26 MHz channel in the 2200-2290 MHz band to communicate with ground stations located in: Pendergrass, Georgia; Haleiwa, Hawaii; Cordoba, Argentina; and Hartebeesthoek, South Africa). Like the commercial operators identified in the references above, General Atomics conducted and completed frequency coordination with the affected federal operators.

7. **Please indicate whether General Atomics will have the technical capability to terminate the supply of power to the NOAA/CNES-supplied UHF/L-band radio or in any other way to pause, terminate, or limit its operations.**

   Yes, General Atomics has the technical capability to terminate the supply of power to the ARGOS-4 payload and to pause, terminate or limit the operations of the ARGOS-4 payload in the exercise of the company's rights as the owner and operator of the OTB-3 satellite.

8. **Please indicate whether General Atomics has the unilateral capability, both technically and legally, to terminate all radiofrequency operations of the satellite. In your response, please**

indicate there are any contractual limitations on General Atomics' ability to exercise any such capability, including but not limited to requirements for prior consultation, specifications concerning required performance, definitions of nominal and off-nominal operations, etc. If so, please describe them in detail and indicate whether those provisions of the contract are subject to any necessary regulatory approvals.

Yes, General Atomics has the unilateral capability, both technically and legally, to terminate all radiofrequency (and other) operations of the satellite. The contract expressly acknowledges that General Atomics is the owner and operator of the OTB-3 satellite and that General Atomics is responsible for ensuring that OTB-3 complies with all laws and requirements.

There are no contractual limitations on General Atomics' ability to exercise such capabilities, but General Atomics has performance requirements under the contract. The company's failure to meet those performance requirements may result in termination of the contract.

9. **The five-year license time frame is described in the application as "to allow the primary RADMON payload sufficient time to gather measurement data on the effects of long-term exposure to radiation on the experiments." Noting the use of the plural "experiments," the only description of an experiment in the application is the RADMON sensor itself. Please provide further explanation of the scope of the experimental program. Please address whether the objectives of this activity could be addressed in conjunction with a license issued under Part 25 of the Commission's rules. Please indicate whether, if the satellite continues to be capable of operation after five years, it is expected that a request to continue operations will be submitted.**

As stated above, the RADMON payload provides measured data on the long-term radiation environment experienced in the LEO environment and correlates the radiation activity with on-board electronics performance. Such electronics includes on board processing and payload interface components built by General Atomics, which will be studied during the life of the program to determine radiation susceptibility of the components and the effectiveness of the General Atomics designed redundant architecture. Additionally, OTB-3 is the first small-satellite (130 kg) designed and built by General Atomics based on Surrey Satellite US heritage technology, and accordingly, the satellite itself is experimental.

For the above reasons, the OTB-3 mission is inherently experimental in nature and General Atomics does not believe that pursuing a Part 25 license is required.

The mission lifetime is expected to be five years. If after this period, OTB-3 and one or more of its payloads continue to be operational, then General Atomics would consider requesting a license renewal to prolong the operations.