

PERFORMANCE WORK STATEMENT

**U.S. Department of Commerce (DOC)
National Oceanic and Atmospheric Administration (NOAA)
Climate Program Office (CPO)**

The Impacts of a Growing Space Industry on Earth's Atmosphere: Research Challenges and Opportunities—A Workshop

SUMMARY

The National Academies of Sciences, Engineering, and Medicine (National Academies) proposes a workshop that would convene the research community, federal agencies, international space agencies, and the commercial space industry to discuss current understanding of atmospheric impacts from rocket launches and satellite reentry and identify gaps that could be informed by future research.

BACKGROUND AND SCOPE

Satellites and their observations provide critical information and services to the global community. Technology advances, lower costs, and commercial investments have catalyzed activity in recent years to launch large satellite constellations (e.g., for GPS, broadband, and surveillance) and commercialize space travel. Global revenue generated from the space industry is forecast to grow from \$350M in 2019 to more than \$ 1 trillion by 2040. This activity will have potentially important environmental effects from the launch, operation, and reentry of spent boosters or rocket stages and re-entering satellites. There is a need to consider the current and future impact on the upper atmosphere from space travel and satellite constellations and key gaps in understanding to inform decision making in an increasingly complex landscape of interested parties.

The space industry is growing and innovating faster than at any time since the start of the space age. The mass of objects in low Earth orbit (LEO) has grown by a factor of ten in the past decade. This growth is expected to continue as governments and private industry plan large LEO satellite constellations and invest in space exploration. Satellites in LEO have short operational lifetimes (5-15 years), meaning they are disposed of through re-entry and replacements may be re-launched.

Rockets emit gaseous and solid chemicals directly into the upper atmosphere, potentially affecting atmospheric composition and global climate. Recent modeling studies have shown that increases in rocket launches may deplete stratospheric ozone and impact radiative forcing from absorbing particles in fuels. When orbital debris reenters the atmosphere, it also produces metal vapors, with additional consequences for stratospheric chemistry and radiative forcing. While there has been relatively more attention towards hazardous objects or debris from reentry, little research has been dedicated to understanding the impacts of the growing space industry on atmospheric composition. This proposed workshop will begin to rectify that gap by exploring the impact of LEO activities on atmospheric conditions.

The landscape of relevant parties in this arena is large and includes domestic and international governments, the academic research community, and the commercial space industry. For example, many US federal agencies have equities via responsibilities in regulation (e.g., FCC regulates satellites and launch vehicles, FAA regulates operator licenses for launch and reentry), research (e.g., NASA, Air Force, and NOAA measure and model atmospheric composition), and applications (e.g., DoD commercial space applications). The National Academies of Sciences, Engineering, and Medicine (National Academies) proposes a workshop that would convene the research community, federal agencies, international space agencies, and the commercial space industry to discuss current understanding of atmospheric impacts from rocket launches and satellite reentry and identify gaps that could be informed by future research.

STATEMENT OF TASK

The National Academies will plan a workshop to bring together experts in the research, public, and private sectors to explore the current and potential future effects on the upper atmosphere from rocket launches and re-entering satellites, and related research gaps. Workshop discussions will include the following topics:

- How do emissions of gases, particles, and other exotic materials from rocket launches and satellite reentry impact the upper atmosphere? What are the key gaps in understanding?
- How is the frequency of rocket launches anticipated to change in the future? What are the key risks to the upper atmosphere from these potential changes in emissions and debris?
- What are the gaps and opportunities for measuring, monitoring, and modeling changes in emissions, atmospheric composition, and the associated environmental impacts?
- How do changes in atmospheric composition and opacity from satellite launches and re-entries affect the ability to conduct scientific research both within and through the Earth's atmosphere (e.g., space and space-based research systems, ground-based observational astronomy, radio signal propagation)?
- What are the needs and opportunities for sharing data and information between governments, private industry, and the research community to inform decision-making?

DELIVERABLES

- **Workshop Committee**

The National Academies will appoint an ad hoc committee of approximately 6-8 members who will plan and facilitate the public workshop. The expertise of the planning committee will include: atmospheric composition and chemistry; ground and space-based atmospheric observations and analysis; global climate modeling; rocket combustion and reentry modeling; aerospace engineering; and ground-based optical and radio astronomy. The committee will reflect the Academies' ongoing efforts to achieve diversity in geographic representation, institutional affiliation, age, gender, race, and other perspectives. The committee will organize the workshop through several virtual meetings. In these meetings, the committee will plan the workshop structure, identify appropriate speakers and attendees, and develop background materials for attendees. Committee members will lead the workshop and serve as session facilitators.

- **Hybrid Workshop**

The workshop will be hybrid with in-person and virtual participation over 2 days. The workshop will include a combination of plenary and breakout sessions to provide multiple channels for input and for the discussions to build throughout the workshop.

- **Workshop Proceedings**

A designated staff rapporteur will prepare a workshop proceedings based on workshop presentations and transcripts. Recordings of plenary sessions will be posted online. The workshop proceedings will be subject to standard National Academies' external review. The workshop proceedings will provide a record of workshop discussions and will not include consensus findings or recommendations. After completion, the final workshop proceedings will be delivered to sponsoring agencies and other interested audiences. A webinar summarizing the proceedings may also be held if there is community interest.

PERIOD OF PERFORMANCE

12 months

SCHEDULE OF DELIVERABLES

Month 1-3 Project start-up, appoint workshop planning committee

Month 4-6 Planning committee meetings virtually to plan workshop

Month 6-7 Workshop held (Washington DC and virtual)

Month 8-10 Draft workshop proceedings; external review of draft proceedings

Month 11-12 Release and disseminate workshop proceedings

POINTS OF CONTACT

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QUALITY ASSURANCE SURVEILLANCE PLAN (QASP)

RESEARCH, TECHNICAL, AND SCIENTIFIC SUPPORT SERVICES FOR THE DEPARTMENT OF COMMERCE / NATIONAL OCEANIC ATMOSPHERIC ADMINISTRATION

1. PURPOSE:

This Quality Assurance Surveillance Plan (QASP) provides a systematic method to evaluate performance for the stated contract. This QASP explains the following:

- What will be monitored.
- How monitoring will take place.
- Who will conduct the monitoring.
- How monitoring efforts and results will be documented.

This QASP does not detail how the contractor accomplishes the work. Rather, the QASP is created with the premise that the contractor is responsible for management and quality control actions to meet the terms of the contract. It is the Government's responsibility to be objective, fair, and consistent in evaluating performance. In addition, the QASP should recognize that unforeseen and uncontrollable situations may occur.

This QASP is a "living document" and the Government may review and revise it on a regular basis. However, the Government will coordinate changes with the contractor. Updates shall ensure that the QASP remains a valid, useful, and enforceable document. Copies of the original QASP and revisions shall be provided to the contractor and Government officials implementing surveillance activities.

a. QASP RELATION TO THE CONTRACT:

QASPs shall be developed and appear in service contract. DOC/NOAA will retain the right to change the surveillance methods and Quality Assurance (QA) procedures, or to increase or decrease the degree of surveillance efforts at any time necessary to assure contract compliance. DOC/NOAA may provide the contractor with an informational copy of the QASP to enable the contractor to enhance its Quality Control Program (QCP).

b. QASP RELATION TO THE QCP:

While the QCP represents the way in which the contractor will ensure its quality and timeliness of services, as defined in the PWS/SOW/SOO, the QASP represents the way in which DOC/NOAA will evaluate the contractor's performance. The contractor's QCP and the QASP should be complementary programs that ensure successful contract performance.

c. REVISIONS TO THE QASP:

The QASP is a tool for use in Government administration of the Performance Work Statement (PWS) /Statement of Work (SOW)/Statement of Objectives (SOO) and remains subject to revision at any time by the Government throughout the contract performance period. Revisions to this surveillance plan are the responsibility of the Contracting Officer's Representative (COR). Changes to the QASP shall be made bilaterally and the Government will provide the contractor an opportunity to revise its Quality Control Plan accordingly.

The contractor shall assume responsibility for all tasks and deliverables in the PWS/SOW/SOO under this award. All operational procedures and quality control measures will be tested and implemented. As the performance period progresses, the levels of surveillance may be altered for service areas in cases where performance is either consistently excellent or consistently unsatisfactory. If observations reveal consistently good performance, then the amount of surveillance may be reduced. If observations reveal consistent deficiencies, increased surveillance may be implemented.

2. GOVERNMENT ROLES AND RESPONSIBILITIES:

The following personnel shall oversee and coordinate surveillance activities.

- a. Contracting Officer (CO) - The CO will ensure performance of all necessary actions for effective contracting, ensure compliance with the contract terms, and shall safeguard the interests of the United States in the contractual relationship. The CO will also assure that the contractor receives impartial, fair, and equitable treatment under this contract. The CO is ultimately responsible for the final determination of the adequacy of the contractor's performance.
- b. Contracting Officer's Representative (COR) –The COR will be responsible for technical administration of the contract, and shall assure proper Government surveillance of the contractor's performance. The COR will keep a quality assurance file. At the conclusion of the contract or when requested by the CO, the COR will provide documentation to the CO. A COR is not empowered to make any contractual commitments or to authorize any contractual changes on the Government's behalf. The contractor shall refer any changes they deem may affect contract price, terms, or conditions to the CO for action.

3. CONTRACTOR ROLES AND RESPONSIBILITIES:

The contractor shall be responsible for delivering products or services in accordance with the Contract. The contractor shall be responsible for implementing a Quality Control Plan (QCP), which is included as part of its technical proposal. The QCP describes the contractor's methods for ensuring all products and services provided under this Contract meet established deliverables and performance standards. The contractor shall be responsible for producing, maintaining, and providing for audit, quality control records and reports and all records associated with the investigation.

Thorough documentation of unperformed or nonconformance is essential for tracking contractor performance throughout the period of performance. The COR will document deficient work by compiling facts describing the inspection methods and results. The COR will develop documentation to substantiate nonconformance with the Contract

4. CONTRACT QUALITY REQUIREMENTS:

Contract quality requirements are the technical requirements in the contract relating to the quality of the product or service and those contract clauses prescribing inspection, and other quality controls incumbent on the contractor, to assure that the product or service conforms to the contractual requirements. Government contract quality assurance shall be performed at such times and places as may be necessary to determine that the supplies or services conform to the contract requirements. Failure to meet or exceed the contract quality requirements is defined as a "nonconformance" on the part of the contractor. The contractor shall be held responsible for any identified nonconformance to items mentioned in the PRS.

The Government's contract quality assurance is defined as follows:

- a. "Acceptance" means the act of an authorized representative of the Government by which the Government, for itself or as agent of another, assumes ownership of existing identified supplies tendered or approves specific services rendered as partial or complete performance of the contract.
- b. "Conditional acceptance" means acceptance of supplies or services that do not conform to contract quality requirements, or are otherwise incomplete, that the contractor is required to correct or otherwise complete by a specified date.
- c. "Minor nonconformance" means a nonconformance that is not likely to materially reduce the usability of the supplies or services for their intended purpose, or is a departure from established standards having little bearing on the effective use or operation of the supplies or services.
- d. "Major nonconformance" means a nonconformance, other than critical, that is likely to result in failure of the supplies or services, or to materially reduce the usability of the supplies or services for their intended purpose.
- e. "Critical nonconformance" means a nonconformance that is likely to result in hazardous or unsafe conditions for individuals using, maintaining, or depending upon the supplies or services; or is likely to prevent performance of a vital agency mission.
- f. "Documentation" means thorough documentation of unperformed or nonconformance is essential for tracking contractor performance throughout the period of performance. The COR will document deficient work by compiling facts describing the inspection methods and results. The COR will develop documentation to substantiate nonconformance with the Contract

5. METHODS OF QUALITY ASSURANCE SURVEILLANCE:

Various methods exist to monitor performance. The COR will use the surveillance methods listed below in the administration of this QASP.

Regardless of the surveillance method, the COR will always contact the contractor's Program Manager or off-site representative when a defect is identified and inform the manager of the specifics of the problem. The COR will be responsible for monitoring the contractor's performance in meeting the contract's quality requirements.

- **DIRECT OBSERVATION:** (Can be performed periodically or through 100% surveillance.)
- **MANAGEMENT INFORMATION SYSTEMS:** (Evaluates outputs through the use of management information reports. Best used for general surveillance and may need to be supplemented by periodic inspections.)
- **PERIODIC INSPECTION:** Uses a comprehensive evaluation of selected outputs. Inspections may be scheduled as required.
 - Analysis of contractor's progress reports. (Evaluate cost, schedule, etc.)
 - Performance reporting.

Surveillance results may be used as the basis for actions (to include payment deductions) against the contractor. In such cases, the Inspection of Services clause in the Contract becomes the basis for the CO's actions.

6. FREQUENCY OF MEASUREMENT:

a. **FREQUENCY OF MEASUREMENT:**

During contract/order performance, the COR will take periodic measurements, quarterly as specified in the AQL column of the Performance Standards Summary Matrix, and will analyze whether the negotiated frequency of measurement is appropriate for the work being performed.

b. **FREQUENCY OF PERFORMANCE ASSESSMENT MEETINGS:**

As required due to performance issues.