

December 20, 2019

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From: NASA HQ/DK/S. Cauffman/ Acting Director, Earth Science Division

Subject: Call for Proposals – Senior Review 2020 for Extension of Earth Science Operating Missions

NASA's Science Mission Directorate (SMD)/Earth Science Division (ESD) periodically conducts comparative reviews of on-orbit missions in extended operations to maximize the scientific return of the Earth Science mission fleet within finite resources, a process called the Senior Review for Extension of Operating Missions. NASA uses the findings from these comparative reviews to define an implementation strategy and give programmatic direction and budgetary guidelines to the missions and projects concerned for the next 6 fiscal years (matching the Federal government's budget planning cycle). This Call describes the objectives and process for the review, including the scope, schedule and evaluation criteria, the Senior Review panels, and provides instructions for the preparation and submission of proposals and in-person presentations to the review panel.

The following thirteen missions (in alphabetical order) are invited to propose to the 2020 Senior Review: Aqua, Aura, CALIPSO, CloudSat, CYGNSS, DSCOVR Earth Science Instruments, ECOSTRESS, GPM, LIS on ISS, OCO-2, SAGE-III, SMAP, and Terra.

#### **Extended Mission Scope:**

The period for this review will cover FY21 through FY26.

ESD's priority for extended missions is *the relevance of the extended dataset within the overall Program of Record as described in the 2017 Decadal Survey*. The ESD Senior Review also explicitly acknowledges (1) the importance of long-term data sets and overall data continuity for Earth science research; and (2) the direct contributions of mission data to national objectives, such as the routine use of near-real-time products from NASA research missions for applied and operational purposes.

The basic mission should include the minimum necessary science review and assessment of instrument performance to verify and validate the data products. The proposal should clearly justify the level of science support required to maintain the quality of the datasets, including calibration and validation activities.

Compared to the prime mission phase, algorithm maintenance is assumed to have become routine and fewer services to external data product users needed during the extended mission.

Mission operations coverage should provide for the safe management of the aging satellite, but compared to the prime mission phase, proposers are encouraged to propose and justify an increased risk of data collection degradation in exchange for an associated reduction in mission cost. For example, greater allowance for hands-off operation and longer data outages for anomaly response should be considered. It is expected that a continuous improvement process will result in reductions in the cost of established activities during the extended mission.

New upper level product development and science investigations are not solicited through the Senior Review. Proposals of this nature are solicited through the ESD Research, Applied Sciences and ESDS Programs.

### Evaluation Criteria

Each mission will be evaluated for science merit, operational utility, technical risk, and cost performance, according to the factors as described below.

- **Science:**
  - Scientific merit of the mission datasets with the proposed years of additional data collection, with special attention to the science that will be enabled by extension. Merit is based on their intrinsic value in investigations by the community into both answering Earth Science questions and enabling future applied uses, relevance to Decadal Survey, and uniqueness of the data among the global observing resources;
  - Quality trends of the standard data products, with a focus on the projected quality for the years of the requested extension, including any change induced by sensor, platform or orbit changes, and the effect of such changes on the overall consistency of the dataset, recognizing the value of long-term data records;
- **Operational and non-research uses:**
  - Utility of the products for “applied and operational uses” that serve national interests, including operational uses, public services, business and economic uses, military operations, government management, policy making, etc.
  - Evaluation factors: intrinsic value, frequency of use, latency.
- **Technical Risk**
  - Hardware status and performance, life expectancy.
  - Mission operations plans for health, safety and data collection.
- **Cost Performance**
  - Cost realism based on historical expenses and allocated funds, and proportion of the projected resources to be used within the Program of Record as specified in the Decadal Survey.

### Funding Environment:

Missions proposing to the ESD Senior Review will compete for an allocation from a pool of funds comprised primarily of the budgets from all of the missions in extended phase. Given the dynamic and constrained budget solution space that the Agency is working within, missions are urged to be cognizant of the fact that all discussions are zero-sum in nature vis-à-vis the overall Earth Science Division’s budget.

### 2020 Review Schedule

The schedule for the 2020 Earth Science Senior Review:

<i>Mission Team Feedback at AGU:</i>	<i>December 8, 2019</i>
<i>Call for Proposals Issued:</i>	<i>December 20, 2019</i>
<i>Proposals Due:</i>	<i>March 6, 2020</i>
<i>National Interests Panel Meets:</i>	<i>April 14-16, 2020</i>
<i>Senior Review Panel Meets:</i>	<i>April 21 &amp; May 12-14, 2020</i>
<i>Panel Questions to Mission Teams:</i>	<i>April 24, 2020</i>
<i>Publication of the Panel’s Report:</i>	<i>June 30, 2020</i>

Changes since 2017 Senior Review

Changes from the Draft Call Letter of 3 December 2019

### **The Senior Review Panels**

The Senior Review is composed of two panels: the Science Panel and the National Interests Panel. The Science Panel is the primary panel. It will be an independent analysis group with sole responsibility to evaluate the scientific merit of each mission's datasets with respect to NASA's Earth science strategic plans and objectives. The Science Panel will be drawn from recognized expert members of the Earth Science research community, and supported by technical and cost experts from within and outside NASA to assess the health and viability of the operating satellites and the proposed mission budgets.

The National Interests Panel will assess the utility and applicability of the mission's data products to satisfy national objectives through non-research use for applied and operational purposes by non-NASA organizations. The National Interests Panel will be drawn from federal, local government, non-profit and commercial users of NASA research data. The National Interests Panel will brief its findings to the Science Panel, who will use the utility findings in its assessments.

The Science Panel will be supported by engineering and cost experts who will conduct focused evaluations of the technical status of the flight and ground hardware systems, and the proposed costs. Both the technical and cost reviews will result in separate risk ratings with narrative text for the feasibility of the extended mission implementation.

### **Senior Review Panel meetings:**

The Technical and Cost experts and the National Interests Panel will meet before the Senior Review Science Panel to permit their findings to be available to the Science Panel. In addition to their evaluations, these panels will provide a set of questions for further clarification from each mission and submit the questions to the Science Panel for their consideration to ask the project teams.

The Senior Review Science panel will meet twice: First, to discuss the proposals and identify topics needing additional clarification; and second, to meet with the mission teams for questions, clarification and mission updates, then finalize their evaluations and develop findings.

#### **1<sup>st</sup> Meeting (April 21):**

Morning: Instructions, Operating Missions background, logistics (writing assignments, etc.), discussion of conflicts of interest and procedures to minimize their impacts.

Afternoon: Discussion of Proposals & Develop Questions for the Projects.

#### **2<sup>nd</sup> Meeting (May 12-14):**

Day 1: Morning: Review Instructions, Operating Missions background, logistics (writing assignments, etc.) and briefings from the National Interests Panel and supporting technical & cost reviewers. Afternoon: Project Presentations.

Day 2: Project presentations.

Day 3: Complete Project Presentations. The Senior Review panel finalizes their evaluations, develops findings, and prepares an initial draft report.

### **Presentations to the Senior Review panel:**

Each proposing project will be allotted time for an oral presentation to the panel, with the time allocation varying depending on the mission size and complexity, with a minimum duration of 30 minutes allotted for any single mission. Two weeks before the presentation, each mission team will be provided a set of questions from the Science Panel and a time allocation. The project team should be represented by no more than three people, supplemented on the flagship missions by no more than one representative per major instrument, or as negotiated with the Senior Review Program Officer. During each project presentation, the project representatives should plan on using no more than one-half of the allocated time for their prepared presentation, reserving one-half for additional questions and answers. The prepared presentation should concisely and thoroughly answer the specific questions that the Science Panel provided to the mission team following their initial review.

- The primary purpose of the oral presentations is to provide a forum for questions from panelists and answers from the projects.
- Secondly, this is an opportunity for projects to provide any significant updates, e.g. changes in technical status since proposal submission.
- Lastly, and with lowest priority, it is an opportunity to repeat highlights of the proposals, which will all have been read and discussed by the panelists.

**Review Outcome:**

The Senior Review Science Panel will produce a report of its findings. The National Interests Panel, and the technical and cost experts will produce reports of their findings and submit to the Science Panel for inclusion in the Science Panel report. The Senior Review Science Panel will provide a mature draft of key findings and conclusions; the Science Panel chair will brief the ESD Director immediately following the panel. Within six weeks, the panel will submit its final written report, which incorporates information from the supplementary panels, to ESD. All the panel reports will be posted later to a public NASA HQ web site.<sup>1</sup>

NASA HQ will consider these findings along with other programmatic issues (orbital debris standards, data systems capacity, etc.) during the FY2022 budget formulation process before finalizing the mission extension decisions. HQ will then relay the new SMD mission extension decisions to each of the proposing missions/projects. The decisions will include new budget guidance, if appropriate, programmatic guidance including possible notices of intent to terminate, and other specific instructions resulting from the Senior Review process. Within four weeks of being informed of the Senior Review decisions, each project must submit back to HQ its plan for complying with the new guidance and instructions, including any documentation updates as required.

The Senior Review Program Officer will ensure that key officials in participating international space agencies or other U.S. government agencies that are partners in a proposing mission are kept informed of the Senior Review process and will be responsible for apprising our partners of NASA's decisions resulting from the Senior Review.

**Instructions for Proposal Format and Content:**

Each mission that is subject to this Senior Review and that is seeking to continue operation shall submit a proposal outlining their mission implementation approach and proposed Project-supported data analysis (DA) for the fiscal years 2021-2026. The proposals must detail and justify how the project will continue to conduct basic mission operations and provide the data products that meet ESD, NASA, and national needs. Proposals should outline how their mission's extended dataset will benefit the Earth Science objectives described in the 2014 Science Plan for NASA's Science Mission Directorate (the SMD Science Plan) and in the 2017 Decadal Survey. Each proposal will contain descriptions of the project's proposed science data analysis activities, recent accomplishments, technical status relating to the ability to deliver the proposed datasets, contributions to national objectives for Earth system monitoring and prediction, and a budget for the proposed activities.

The proposal shall contain a science section, a technical/budget section, and five appendices containing a mission data product inventory, budget spreadsheets, references, a list of acronyms, and an engineering data supplement.

For all missions except the Terra and Aqua flagship missions, the scientific and technical/budget sections should be no more than 40 pages; Terra should not exceed 50 pages and Aqua should not exceed 42 pages. All pages are to be in single-column format, on 8.5-inch by 11-inch paper, with character (font) size not less than 12 points. Not included in the page limits are the five Appendices. The proposal must be submitted in PDF format with the budget spreadsheets in XLS format (see below). (If your institution requires signatures, please place them on one separate submittal letter; copies of this submittal letter will not be used in the peer review but will be retained within the ESD. The project name and names of key authors at the top of the first page will suffice for review purposes.)

<sup>1</sup> See for example: <https://science.nasa.gov/earth-science/missions/operating>. Reports from the prior (2005-2017) Senior Reviews are currently available on this site.

The Terra and Aqua missions will include one additional appendix comprising the mini-proposals for the existing algorithm maintenance. This additional appendix is not included in the page limits. The precise format and content of each mini-proposal will be determined separately by the Terra and Aqua Project Scientists, with the expectation that the Senior Review appendix will contain a statement of work and summary budget for each algorithm maintenance mini-proposal, for the period 2020-2026. The main body of the Terra and Aqua proposals should contain an executive summary of the mini-proposals that includes a description of what the algorithms collectively do for the mission, a description of the mission's management approach for these algorithm maintenance projects, and a bottom-line budget; two pages have been added to the page limits for these two missions to accommodate this section.

**Instructions for the Science Section:** The science section should comprise approximately two-thirds of the proposal and address four major topics: science merit, data products, applied and operational uses, and programmatic elements.

Science Merit: Describe how the additional years of data collection will enhance the science merits of your mission datasets and the specific contributions of the instruments within your mission. Describe the science objectives for the next 3-6 years, specifying changes, if any, from current science objectives. Summarize the accomplishments of the past three years and describe the mission's plans for the next 3-6 years. Explain how the continuation of the mission datasets and the proposed science program contribute to the ESD objectives as stated in the SMD Science Plan and the 2017 Decadal Survey, and to the ESD Program of Record as described in the Decadal Survey.

Data Products: Describe how the mission will maintain/manage the standard data products during the extension, including discussion of any current or predicted instrument or spacecraft performance degradations that affect the quality of those products. Discuss the history/trend of product quality over the life of the mission, with attention to the three years since the last Senior Review. Resources required for routine calibration, validation, and algorithm maintenance to maintain the quality of these data products should be included. The proposal narrative should focus on the work that is being performed by the core DA science team. A list of standard data products, highlighting changes since the last Senior Review, should be included in Appendix A. This list in Appendix A must include a table, or otherwise indicate which standard products are developed/maintained by the core DA science team, or by a separately-funded science team.

For standard data products that rely on data from missions or instruments outside of the proposing project's control, identify the required external resource. If all NASA parties in the shared data product are proposing in response to this letter, each mission should detail its own elements of the task along with the complementary support from the other mission(s).

Applied and Operational Uses: Describe the merits and specific contributions of the mission to applied and operational uses (i.e. non-research use). The proposal should convey the value of datasets for applications that serve national interests (operational uses, public services, military operations, etc). Clearly summarize what has been accomplished in the past two years for applied and operational uses, including technical specifics and well-described examples. Explain how the proposed mission extension contributes to the applications-oriented objectives as stated in the SMD Science Plan.

Programmatic Elements: Briefly summarize the programmatic elements required for mission implementation, including the geographic and organizational locations of key mission elements (science management, project management, ground station, science data acquisition and distribution center, etc.), and the identification and roles of any international or inter-Agency partners. Also identify any parallel funding sources that are *required* for supporting any of the activities in these mission extension proposals, both for efforts already funded and for anticipated future funding.

Projects should consider providing an on-line bibliography of recent publications. The proposal should contain the URL/web address to this bibliography. Bibliographies included in the text of the proposal will be counted against the page limit.

**Instructions for the Technical/Budget Section:** This section should be approximately one-third of the proposal and address two major topics: technical status and a budget narrative.

**Technical Status:** Discuss the overall technical status of the elements of the mission, and the team's approach to managing operations to optimize health and vitality of the elements. Include the spacecraft, instruments, and ground systems including spacecraft control center and science center(s). Summarize actions taken to improve the effectiveness of the mission operations tasks and describe what improvements have been accomplished. Summarize the health of the elements and point out limitations as a result of degradation, aging, use of consumables, obsolescence, failures, orbit changes, etc. Hosted instruments, especially those on the International Space Station, should address accommodation issues such as cleanliness or duty cycles, that may affect the dataset. Include an estimate and rationale of mission life expectancy, including an estimate of post-mission lifetime (assuming the initial 3-year extension) and an updated estimate of the reliability to accomplish your planned end-of-mission passivation procedure (also assuming the 3-year extension). Provide supporting data in the form of engineering data tables and figures in Appendix E.

**Budget Narrative:** *The budgets that will be submitted in the parallel Program Planning & Budget Execution (PPBE) 2022 process must be fully consistent with those proposed in the Senior Review.*

*Each mission must submit an in-guideline proposal. For missions which choose to submit an optimal/over-guideline scenario, a second over-guideline total budget submittal is also required. The budget narrative must clearly describe the additional scope, and the science narrative must be equally clear regarding the benefits provided through both the in-guide and over-guide funding, and the difference between the two scenarios.*

- **In-Guideline Scenario:** Describe a scenario that does not exceed the baseline allocation provided in the Guideline Mission Spreadsheets provided by your responsible Program Office (Earth Systematic Missions or Earth System Science Pathfinder). The in-guide budget allocation matches the NASA Operating Plan ("N2" budget). If the Project believes that the guideline is sufficient to support a viable mission, but not the present set of products and activities, the project should identify the set of activities and products that will be supported, those that will not, and the impacts of any adjustments in work content on the science return for the mission.
- **Optimal Scenario:** You may describe a funding level that leads to a more effective or efficient mission, improves data continuity/quality, or enables new science for marginal costs, while still recognizing the tight fiscal constraints placed on the combined Program of Record and future Decadal Survey missions. The technical/science description of this scenario should clearly define the discrete items or activities mapped to the WBS (see Attachment A) and expected benefits compared to an in-guideline scenario.

Labor, major equipment and other expenses must be explained in sufficient detail to determine the incremental cost of each proposed task. The budget must include all project-specific costs including mission services performed at GSFC by the ESMO Project, at JPL, by NASA's networks such as the Ground Network (GN), the Space Network (SN), or the NASA Communications Network.

Summarize anticipated 'in kind' support from NASA-funded sources other than the project's MO&DA budget. These 'in kind' sources include but are not limited to: processing of mission data to generate core data products by the ESDS Program; satellite tracking support from NASA networks; and support from the multi-mission infrastructure projects at GSFC, JPL, and elsewhere. Supporting or in-kind sources that should NOT be included in the budget tables: algorithm development activities funded through ROSES; airborne science infrastructure; supporting activities from non-NASA sources such as international partners, other US Government agencies. However, the extent of the partners' participation should be identified in the narrative.

Attachment A to this letter contains the Work Breakdown Structure and definitions for "MO" and "DA." Attachment B contains instructions and the mandatory form for the budget portion of each. Attachment C contains the additional template to be used as a supplement to the budget narrative. As before, this is requested for only one year.

Changes since 2017 Senior Review

Changes from the Draft Call Letter of 3 December 2019

Civil service labor is included in the budget allocations.

**Required Appendices:** Five appendices are required and do not count against the page limit:

Appendix A: Mission Data Product Inventory. Include a brief (no more than 100 words per product suggested) summary description of the data product; the approximate time duration of the data record; the instrument(s) required to produce the product; the maturity of the algorithm(s) required to produce the product; the primary NASA and/or applied and operational users (including contact information such as phone or e-mail addresses, if known); and the availability and location of the product for community use and access. The inventory must include a summary table that contains as a minimum the following columns: Data Product Name, Data Product Description, and Algorithm Source (ROSES or Mission DA). Sample data product tables will be provided at the Senior Review Library (see “Further Information” below).

Appendix B: Mission budget in specified format. Attachment B describes the mandatory formats for your budget request and supplies spreadsheet templates. The additional budget content format from Attachment C may be submitted here, although the preferred location is part of the budget narrative in the body of the proposal. Supplementary, detailed cost information to assist the cost evaluation is encouraged, and does not count against the page limit.

Appendix C: Acronym list

Appendix D: References actually cited in the text of the proposal.

Appendix E: Technical data (e.g. engineering data, consumables and predicted utilization, performance degradation) to support the spacecraft and/or instrument projected performance and life expectancy.

Appendix F: Terra and Aqua only. The mini-proposals for algorithm maintenance submitted by the investigators of existing algorithms.

#### **Proposal Submission:**

Proposals must be uploaded electronically in PDF format to <https://nspires.nasaprs.com/external/> and must be received by COB on March 6, 2020. The budget spreadsheets should be incorporated into the PDF proposal document, and also submitted in Excel format (XLS or XLSX) via email to the Senior Review Program Officer.

#### **Further Information**

A resource library website has been established [http://soma.larc.nasa.gov/2020esd\\_seniorreview/](http://soma.larc.nasa.gov/2020esd_seniorreview/). Proposers may have requests for clarification on any of the items contained in this letter or on the website. For further information, contact the Senior Review Program Officer, Jamie Wicks, [jamie.wilson.wicks@nasa.gov](mailto:jamie.wilson.wicks@nasa.gov), or at the address below. The ESD will review all requests for information and if additional updates are sent out they will be shared with all proposers. It is the sole discretion of the ESD to determine which, if any, clarifications are required.

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Three attachments:

- A. Definitions of the Work Breakdown Structure for NASA Science Operating Flight Missions
- B. MS Excel spreadsheet: ESD Senior Review FY16-FY19\_Spreadsheet.xls
- C. Supplemental Budget Narrative Template

FINAL



## Attachment A: Definitions of Work Breakdown Structure for NASA Science Operating Missions

The WBS elements shown below are intended for flight projects in all phases of implementation, from pre-Phase A through mission termination and disposal. The Projects should use the WBS dictionary for guidance on how to break out their proposed costs, but as general suggestion for missions in operation, and in particular in extended operations beyond the primary mission phase, only a subset of the standard WBS elements are expected to show any activity. Among the eleven level 2 WBS categories identified below, active elements for our missions would reasonably be:

- 1.0 Project Management
- 4.0 Science/Data Analysis
- 7.0 Mission operations
- 9.0 Ground systems
- 11.0 Education & Public Outreach (*NOT USED*)

Management of the mission elements could be accounted for in either Project Management (1.0) or Science (4.0), with the projects defining the appropriate distribution in their proposals. Any efforts related to Systems Engineering (2.0), Safety and Mission Assurance (3.0), Payload (5.0) and Spacecraft (6.0) could reasonably be folded into Mission Operations (7.0) for extended missions. Launch vehicles (8.0) and Systems Integration and Testing (10.0) clearly are no longer applicable.

### (Taken from NASA WBS Handbook, January 2010)

Standard Level 2 WBS elements for space flight projects are shown in Figure G.4-1. The standard WBS template below assumes a typical spacecraft flight development project with relatively minor ground or mission operations elements. For major launch or mission operations ground development activities which are viewed as projects unto themselves, the WBS may be modified. For example, the spacecraft element may be changed to reflect the ground project major deliverable product (such as a facility). The elements such as payload, launch vehicle/services, ground systems, mission operations system that are not applicable may be deleted.

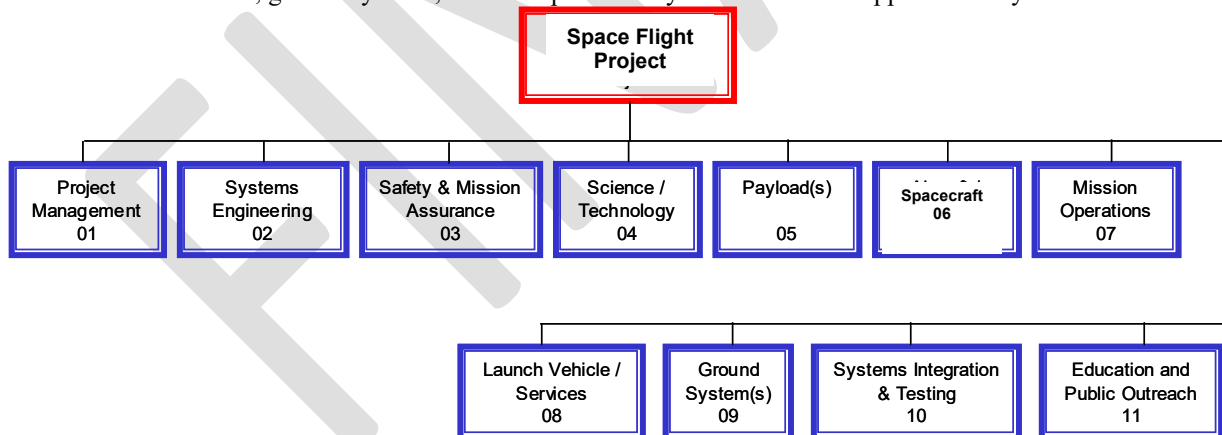


Figure G.4-1 Standard Level 2 WBS Elements for Space Flight Projects

### Space Flight Project Standard WBS Dictionary

**Element 1 – Project Management:** The business and administrative planning, organizing, directing, coordinating, controlling, and approval processes used to accomplish overall Project objectives, which are not associated with specific hardware or software elements. This element includes project reviews and documentation, non-project owned facilities, and project reserves. It excludes costs associated with technical planning and management, and costs associated with delivering specific engineering, hardware and software products.

**Element 2 – Systems Engineering:** *[Include in 7.0, Mission Operations.]* The technical and management efforts of directing and controlling an integrated engineering effort for the project. This element includes the efforts to define the project space flight vehicle(s) and ground system, conducting trade studies; the integrated planning and control of the technical program efforts of design engineering, software engineering, specialty engineering, system architecture development, and integrated test planning, system requirements writing, configuration control, technical oversight, control and monitoring of the technical program, and risk management activities. Documentation products include requirements documents, interface control documents (ICDs), Risk Management Plan, and master verification and validation (V&V) plan. Excludes any design engineering costs.

**Element 3 – Safety and Mission Assurance:** *[Include in 7.0, Mission Operations.]* The technical and management efforts of directing and controlling the safety and mission assurance elements of the project. This element includes design, development, review, and verification of practices and procedures and mission success criteria intended to assure that the delivered spacecraft, ground systems, mission operations, and payload(s) meet performance requirements and function for their intended lifetimes. This element excludes mission and product assurance efforts at partners/ subcontractors other than a review/oversight function, and the direct costs of environmental testing.

**Element 4 – Science / Technology:** This element includes the managing, directing, and controlling of the science investigation aspects, as well as leading, managing, and performing the technology demonstration elements of the Project. The costs incurred to cover the Principal Investigator, Project Scientist, science team members, and equivalent personnel for technology demonstrations are included. Specific responsibilities include defining the science or demonstration requirements; ensuring the integration of these requirements with the payloads, spacecraft, ground systems, mission operations; providing the algorithms for data processing and analyses; and performing data analysis and archiving. This element excludes hardware and software for on-board science investigative instruments / payloads.

**Element 5 – Payload:** *[Include in 4.0, Science.]* This element includes the equipment provided for special purposes in addition to the normal equipment (i.e., GSE) integral to the spacecraft. This includes leading, managing, and implementing the hardware and software payloads that perform the scientific experimental and data gathering functions placed on board the spacecraft, as well as the technology demonstration for the mission.

**Element 6 – Spacecraft(s):** *[Include in 7.0, Mission Operations.]* The spacecraft that serves as the platform for carrying payload(s), instrument(s), humans, and other mission-oriented equipment in space to the mission destination(s) to achieve the mission objectives. The spacecraft may be a single spacecraft or multiple spacecraft/modules (i.e., cruise stage, orbiter, lander, or rover modules). Each spacecraft/module of the system includes the following subsystems as appropriate: Crew, Power, Command & Data Handling, Telecommunications, Mechanical, Thermal, Propulsion, Guidance Navigation and Control, Wiring Harness, and Flight Software. This element also includes all design, development, production, assembly, test efforts and associated GSE to deliver the completed system for integration with the launch vehicle and payload. This element does not include integration and test with payloads and other project systems.

**Element 7 - Mission Operations System:** The management of the development and implementation of personnel, procedures, documentation and training required to conduct mission operations. This element includes tracking, commanding, receiving/processing telemetry, analyses of system status, trajectory analysis, orbit determination, maneuver analysis, target body orbit/ephemeris updates, and disposal of remaining mission resources at end-of-mission. The same WBS structure is used for Phase E Mission Operation Systems but with inactive elements defined as “not applicable.” However, different accounts must be used for Phase E due to NASA cost reporting requirements. This element does not include integration and test with the other project systems.

**Element 8 – Launch Vehicle / Services:** *[Not applicable for operating missions.]* The management and implementation of activities required to place the spacecraft directly into its operational environment, or on a trajectory towards its intended target. This element includes launch vehicle; launch vehicle integration; launch operations; any other associated launch services (frequently includes an upper-stage propulsion system), and

associated ground support equipment. This element does not include the integration and test with the other project systems.

**Element 9 – Ground System(s):** The complex of equipment, hardware, software, networks, and mission-unique facilities required to conduct mission operations of the spacecraft systems and payloads. This complex includes the computers, communications, operating systems, and networking equipment needed to interconnect and host the Mission Operations software. This element includes the design, development, implementation, integration, test and the associated support equipment of the ground system, including the hardware and software needed for processing, archiving and distributing telemetry and radiometric data and for commanding the spacecraft. Also includes the use and maintenance of the project testbeds and project-owned facilities. This element does not include integration and test with the other project systems and conducting mission operations.

**Element 10 – Systems Integration and Testing:** *[Not applicable for operating missions, or include in 7.0 Mission Operations.]* This element includes the hardware, software, procedures and project-owned facilities required to perform the integration and testing of the project’s systems, payloads, spacecraft, launch vehicle / services, and mission operations.

**Element 11 – *NOT USED***

Additional work element definitions:

“Data Analysis” encompasses the work scope defined in Element 4 above, and specific project-funded data processing of Level 1 and above products. Activities typically included in “Data Analysis” are: customized data processing, analysis activities, documentation, presentation and publication of scientific results, science events planning, instrument and observation performance analysis, science data calibration, validation and certification of processed data, science operations centers, etc.

“Mission Operations” encompasses the work scope defined in Element 7 above, data acquisition and processing through Level 0 only. Activities typically included in “Mission Operations” are: command generation and telemetry monitoring; health and performance monitoring of the spacecraft, instruments, and ground system; mission analysis and planning/scheduling; spacecraft resource (power, etc) constraints analysis; trajectory, orbit, attitude planning and determination, etc.

“Competed Science” or “Competed Data Analysis” encompasses investigations solicited through ROSES.

## Attachment B: Budget Template

### Instructions for the Budget Spreadsheet

#### General Guidelines

Show all costs in Real-Year K DOLLARS.

For those missions with budgeted activities at more than one NASA center provide the full cost budget for each Center in both Table I (Budget by Cost Elements/labor, travel and procurements) and Table II (Budget by WBS).

The approved budgets are for the entire year shown, if the prime mission ends in the middle of a fiscal year, show the total budget for that year, covering both prime and extended operations.

The budget totals (all Centers) for the Budget Tables I, II, and III should match, and should equal the top-level approved budget provided on the \$K template.

**Note: Budget totals and breakouts by MO/DA must be consistent with PPBE submission.**

#### Table I FY21 - FY26 Approved Budget by Cost Element by Center

Separate entries should be made for each supporting Center.

#### Table II FY21- FY26 Approved Budget By WBS By Center

Describe how your project's budget breaks down by function

The rows in Tables II correspond to the WBS definitions shown in Attachment A to the Call for Proposals.

Separate entries should be made for each supporting Center.

- o Only Civil Servants should be entered under FTE line
- o WYEs Onsite include all NASA center on-site/near site contractor workforce.
- o WYEs Offsite include any NASA far offsite workforce and/or remote non NASA workforce (i.e. SORCE @ LASP , etc.)

*Note: WBS 11/EPO has been deleted*

#### Table III FY121- FY26 Approved Budget by Instrument Team

Table III is required only for Terra, Aqua and Aura. Other missions should leave this table blank.

Describe how your budget breaks down by the instrument teams.

"Other Science teams" may apply to cross instrument science teams and efforts.

"Other expenses" may apply to shared services such as mission operations, E/PO, Cal/Val, etc..

#### Table IV FY21 - FY26 FTE Template

Fill in FTEs or WYEs as appropriate.

- o Only Civil Servants should be entered under FTE line
- o WYEs Onsite include all NASA center on-site/near site contractor workforce.
- o WYEs Offsite include any NASA far offsite workforce and/or remote non NASA workforce (i.e. SORCE @ LASP, etc.)

#### Table V Supplemental Budget Narrative FY21 Only

**Workforce (the mission may itemize by center, but not required).**

Note: this sheet has 4 workforce categories, NASA CS FTEs, JPL WYEs, WYEs and Other WYEs.

The previous workforce definitions still apply, **in this sheet the JPL WYEs should be shown on their own line.**

WYE= Near or On Site

Other WYEs: Offsite work such as SORCEat LASP etc.

**Budget:** The mission may itemize by center, but not required.

**C.S. Labor:** Consider itemizing by Center, Instrument, etc.

**Travel:** Consider itemizing by type, e.g. Conference, Science Team Meetings, Program meetings, etc. Includes C.S. travel only summarize as you choose.

**Contracts:** List each contract, company/institution, work scope, include fully loaded labor, travel & materials/other purchases

**Grants:** List each university, work scope, annual cost

**Materials and other Purchases:** Summary estimate, group as appropriate-include items directly purchased-supplies etc (in other words, not through a contract.

Changes since 2017 Senior Review

Changes from the Draft Call Letter of 3 December 2019

BUDGET TEMPLATE												
Project :	WBS											
Contact:	Phone #:											
	FY21	FY22	FY23	FY24	FY25	FY26						
Budget	\$0.000											
Total Budget Input:	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
Delta: Submit to Approved:	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
<b>Table I Approved Budget by Cost Element and Center</b>												
	FY21	FY22	FY23	FY24	FY25	FY26						
<b>GSFC</b>												
1000 Labor												
2100 Travel												
3000 Procurements												
Total*	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
<b>JPL</b>												
1000 Labor												
2100 Travel												
3000 Procurements												
Total*	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
<b>LARC</b>												
1000 Labor												
2100 Travel												
3000 Procurements												
Total*	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
<b>Other Center</b>												
1000 Labor												
2100 Travel												
3000 Procurements												
Total*	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
<b>Other Center</b>												
1000 Labor												
2100 Travel												
3000 Procurements												
Total*	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
<b>TOTAL - Includes all Applicable Centers/Organizations</b>												
1000 Labor	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
2100 Travel	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
3000 Procurements	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
Total*	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
<b>Table II Approved Budget by WBS and Center</b>												
	FY21		FY22		FY23		FY24		FY25		FY26	
<b>GSFC</b>	SK	FTE, WYE	SK	FTE, WYE	SK	FTE, WYE	SK	FTE, WYE	SK	FTE, WYE	SK	FTE, WYE
<b>4.0 Science</b>												
Science (other than labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
<b>7.0 Mission Operations</b>												
Mission Ops (other than Labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
Total*	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
<b>JPL</b>												
<b>4.0 Science</b>												
Science (other than labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
<b>7.0 Mission Operations</b>												
Mission Ops (other than Labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
Total*	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
<b>LARC</b>												
<b>4.0 Science</b>												
Science (other than labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
<b>7.0 Mission Operations</b>												
Mission Ops (other than Labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
Total*	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
<b>(Other Center-List)</b>												
<b>4.0 Science</b>												
Science (other than labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
<b>7.0 Mission Operations</b>												
Mission Ops (other than Labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
Total*	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
<b>(Other Center-List)</b>												
<b>4.0 Science</b>												
Science (other than labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
<b>7.0 Mission Operations</b>												
Mission Ops (other than Labor)												
FTE Labor												
WYE Onsite Labor												
WYE Offsite Labor												
Total*	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
<b>TOTAL - Includes all applicable Centers/Organizations</b>												
<b>4.0 Science</b>	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
Science (other than labor)	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
FTE Labor	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
WYE Onsite Labor	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
WYE Offsite Labor	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
<b>7.0 Mission Operations</b>	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
Mission Ops (other than Labor)	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
FTE Labor	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
WYE Onsite Labor	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
WYE Offsite Labor	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
Total*	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0	\$0.0	0 0
* Totals for Table II should be equal to the year by year totals in Table I.												
<b>Table III Approved Budget by Instrument Team AQUA, AURA &amp; TERRA Only</b>												
	FY21	FY22	FY23	FY24	FY25	FY26						
1. Instrument A												
2. Instrument B												
3. Instrument C												
4. Instrument Teams												
Other mission expenses												
Total*	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -						
* Totals for Table III should be equal to the year by year totals in Table I.												

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