GDC Science Investigations, SALMON-3 Program Element Appendix Technical, Management and Cost Evaluation Overview: Pre-Proposal Conference

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Outline

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Introduction

Purpose of this Presentation

1. Present a short overview of the Technical, Management and Cost (TMC) Evaluation of proposals submitted as a result of the GDC Science Investigations Program Element Appendix (PEA) of the Third Stand Alone Missions of Opportunity Notice (SALMON-3) Announcement of Opportunity (AO).
2. Point to reference documents
3. Answer questions

Important Notes:

- This PEA is to the SALMON-3 AO which is based on SMD's Standard PI-Led Mission AO.
- **All proposers must read this PEA & the SALMON-3 AO carefully, and all proposals must comply with the requirements and constraints contained within the two documents.**

GDC PEA Highlights & SALMON-3 Reminder

GDC PEA Highlights

Introduction

Investigations proposed in response to this solicitation must,

- Support the goals and objectives of GDC (Section 2.4)
- Be implemented by Principal Investigator (PI) led investigation teams (Section 1.1)
- Be implemented through the provision of complete spaceflight investigations (Section 1.1)

Proposed investigations will be evaluated and selected through a single-step competitive process (Section 3).

- The single-step competitive process entails the solicitation, submission, evaluation, and selection of proposals prepared in response to this PEA.
- NASA intends to select several investigations for funding through all Phases (A-F) of mission development for flight and operations.

GDC PEA Highlights

Instrument Characteristics and Interface Requirements (Section 5.3.1)

- The expected duration of the GDC prime mission is 3 years and the expected duration of an extended mission is 2 years.
- Therefore, instruments should be designed for a lifetime of at least 3 years and carry sufficient consumables for at least 5 years.

Requirement P-14 Proposals shall clearly state the proposed instrument mass, volume dimensions, power requirements, platform stabilization requirements, thermal requirements, observational geometry requirements, launch vibration constraints, electromagnetic interference/electromagnetic compatibility (EMI/EMC) requirements, data rate requirements, lifetime, and all other requirements (or constraints, preferences, etc.) that the instrument places on the platform for accommodation, launch, deployment, operations, etc.

A Template for an Instrument Accommodations Table is provided in the Program Library to aid proposers to provide this data.

This table shall be provided in the experiment implementation section (Section E) of the proposal.

This table does not count towards the proposal page limit.

This table shall also be provided as an Excel file as described in Section 6.2.2.

GDC PEA Highlights

Mission Category and Payload Risk Classification (Section 5.3.3)

- The NASA Science Mission Directorate (SMD) has determined that the GDC investigations to be selected as a result of this PEA will be Category 2 projects (per NPR 7120.5E).
- The GDC mission is designated as Class C with Class C payloads (per NPR 8705.4).
- The expected duration of the GDC prime mission is 3 years and the expected duration of an extended mission is 2 years.
- Therefore, instruments should be designed for a lifetime of at least 3 years and carry sufficient consumables for at least 5 years.

GDC PEA & SALMON-3 Reminders

New Technologies/Advanced Engineering Developments (PEA Section 5.3.4 & SALMON-3 Section 5.3.5)

This PEA solicits science investigations, not technology or advanced engineering development projects. Proposed investigations are generally expected to have mature technologies, with systems at a Technology Readiness Level (TRL) of 6 or higher.

For the purpose of TRL assessment, systems are defined as level 3 WBS payload developments (i.e., individual instruments); see Figure 3-7 of the *NASA WBS Handbook*, NASA/SP-2010-3404, which can be found in the Program Library.

TRLs are defined in NPR 7123.1B *NASA Systems Engineering Processes and Requirements*, Appendix E, which can be found in the Program Library.

Proposals with a limited number of less mature technologies and/or advanced engineering developments are permitted as long as they contain a plan for maturing systems to TRL 6 (see NASA/SP-2007-6105 Rev 1, *NASA Systems Engineering Handbook*) by no later than Preliminary Design Review (PDR) and adequate backup plans that will provide mitigation in the event that the systems cannot be matured as planned.

The TRL state of systems will be validated by an independent team at PDR.

SALMON-3 Requirement 35. Unless otherwise specified in the applicable PEA, proposals that use systems currently at less than TRL 6 when proposed shall include a plan for system maturation to TRL 6 by no later than PDR **and** a backup plan in the event that the proposed system cannot be matured as planned.

GDC PEA Highlights

Scientific/Technical Evaluation Factors (Section 7.1)

- In addition to the evaluation factors given in Section 7.2.4 of the SALMON-3 AO, the evaluation of the TMC feasibility of the proposed investigation implementation also includes the following factor:

Factor C-6. Adequacy and robustness of the instrument manufacturing plan.

This factor includes the ability to build, test, and integrate the required number of flight instruments with repeatable quality and performance standards on the required schedule.

This factor also includes evaluation of the instrument design's impact on the repeat manufacturability, the proposer's management of any subcontracted manufacturer, and the ability to capture and apply lessons learned for the effective production of subsequent units.

This plan shall be provided in Appendix J.14, for which there is 4 page limit.

GDC PEA Highlights

Scientific/Technical Evaluation Factors (Section 7.1) continued

Appendix J.14 should include answers to the following questions.

- How does the design of the instrument affect the manufacturing, integration, and test (I&T) processes?
- How does the design of the instrument and manufacturing plan address repeatability and quality consistency in the build processes?
- Does the proposing team sufficiently describe how the instrument will be consistently manufactured in the quantities required for the mission?
- Is sufficient rationale provided to define the manufacturing and I&T steps that are done in sequence versus in parallel?
- Are appropriate management methods and resources in place to oversee the procurement, subcontracting, and manufacturing processes?
- How is the I&T team staffed for the instrument production run?
- Are facilities and Ground Support Equipment (GSE) defined to support the production plan for multiple units?

GDC PEA Highlights

Scientific/Technical Evaluation Factors (Section 7.1) continued

Appendix J.14 should include answers to the following questions.

- Is sufficient schedule available and are schedule oversight processes in place to monitor the instrument production line?
- What are the plans for incorporating results and/or lessons learned from assembly, test, and calibration of the early development and/or flight units into the processes for the later units?
- What is the sparing plan or philosophy for the instrument production run?
- What are the plans for calibration of the multiple flight units, including specialized, one-of-a-kind calibration facilities that are required, and evaluation of schedule impacts of serial calibration activities, as well as inter-calibration and cross-calibration activities?

GDC PEA Highlights

Selection for Technical Maturation (Section 7.2.2)

- NASA recognizes that the determination of the **local neutral wind velocity** 1) is a **key measurement** for the GDC mission, potential future upper atmosphere studies, and for National space weather efforts; and 2) has a **lower level of flight heritage** and technical readiness compared to other relevant spaceflight instrumentation.
- NASA further **recognizes the benefit** to the Agency, the Nation, and the taxpayer of having **multiple** reliable providers of key technologies.
- NASA reserves the right to select at least one proposed instrument with this measurement capability for additional technical maturation.
- NASA would maintain an option of accommodating the instrument on at least one future spaceflight opportunity, but this option would not constitute a guarantee of accommodation on any future spaceflight opportunity.
- This instrument **would not** be selected as part of or managed by the GDC project.
- The technical maturation activity will be contracted through and managed by the LWS Program Office.
- The selection will be based upon the ability to mature to TRL 6 on a schedule parallel to the GDC project development timeline.
- The selection will take into consideration diversity of instrument providers and measurement techniques.
- Instruments eligible for selection for this targeted technical maturation will not be limited to those proposals that are categorized as Category III (see Section 7.1.2 of the SALMON-3 AO).

TMC Evaluation

TMC Evaluation

Evaluation Criteria

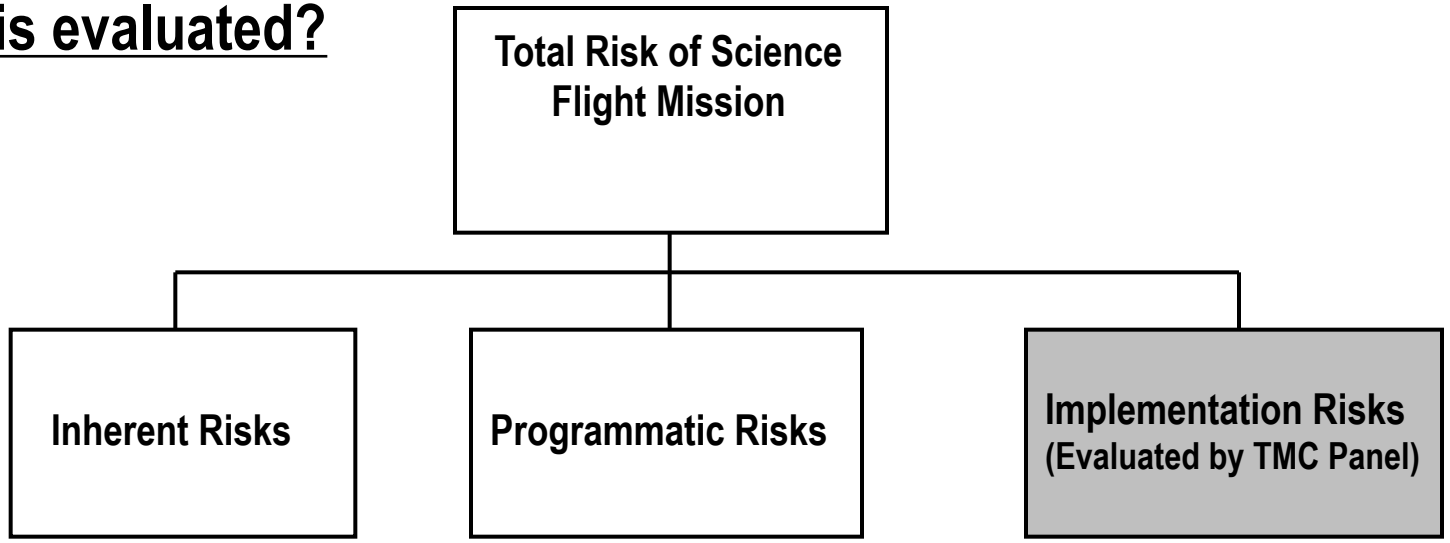
- Intrinsic Science Merit of the Proposed Investigation
- Experiment Science Implementation Merit and Feasibility of the Proposed Investigation
- **TMC Feasibility of the Proposed Investigation Implementation**

Weighting: the first criterion is weighted approximately 40%; the second and **third criteria are weighted approximately 30%** each.

TMC Evaluation: The purpose of the TMC evaluation is to assess the likelihood that the submitted investigations' technical and management approaches can be successfully implemented as proposed, including an assessment of the likelihood of their completion within the proposed cost and schedule.

TMC Evaluation

What is evaluated?



Risks that are unavoidable to do the investigation:

- Launch environments
- Space environments
- Mission durations
- Unknowns
- Etc.

Risks that are uncertainties due to matters beyond project control:

- Environmental Assessment approvals
- Budgetary uncertainties
- Political impacts
- Late/non-delivery of NASA provided project elements
- Stability and reliability of proposed partners and their contributions
- Etc.

Risks that are associated with implementing the investigation:

- Adequacy of planning
- Adequacy of management
- Adequacy of development approach
- Adequacy of schedule
- Adequacy of funding
- Adequacy of Risk Management (planning for known & unknown)

TMC Evaluation

TMC Evaluation Purpose and Principles (1 of 2)

TMC evaluation purpose: to assess the likelihood that the submitted investigations' technical and management approaches can be successfully implemented as proposed, including an assessment of the likelihood of their completion within the proposed cost and schedule.

- Basic Principles:
  - It is assumed that the proposer is the expert on his/her proposal.
  - Proposer's task is to demonstrate that the investigation implementation risk is low.
  - TMC panel's task is to try to validate proposer's assertion of low risk.
- Merit is to be assessed on the basis of material in the proposal and the clarifications.
- All Proposals are evaluated to identical standards and not compared to other proposals.
- TMC Panels consist of evaluators who are experts in the factors that they evaluate.

TMC Evaluation

TMC Evaluation Purpose and Principles (2 of 2)

- TMC Panels develop findings for each proposal - Findings: "As expected" (no finding), "above expectations" (strengths), "below expectations" (weaknesses). Risk Ratings should reflect the written strengths and weaknesses.
- The Cost Analysis is integrated into overall Risk Rating.
- Proposal Risk Assessment: Proposals are based on Pre-Phase-A concepts; TMC Risk Assessments give appropriate benefit of the doubt to the Proposer.

TMC Evaluation

TMC Evaluation Factors; Section 7.2.4 of the SALMON-3 AO & Section 7.1 of the PEA

Factor C-1. Adequacy and robustness of the instrument implementation plan.

Factor C-2. Adequacy and robustness of the mission design and plan for mission operations.

Factor C-3. Adequacy and robustness of the flight systems.*

Factor C-4. Adequacy and robustness of the management approach and schedule, including the capability of the management team.

Factor C-5. Adequacy and robustness of the cost plan, including cost feasibility and cost risk.

Factor C-6. Adequacy and robustness of the instrument manufacturing plan.

**Factor C-3 is not applicable to the GDC PEA.*

TMC Evaluation

TMC Evaluation Findings Definitions

Major and minor strengths and weaknesses are defined as follows:

Major Strength: A facet of the implementation response that is judged to be well above expectations and can substantially contribute to the ability of the project to meet its technical requirements on schedule and within cost.

Minor Strength: A strength that is worthy of note and can be brought to the attention of Proposers during debriefings, but is not a discriminator in the assessment of risk.

Major Weakness: A deficiency or set of deficiencies taken together that are judged to substantially weaken the project's ability to meet its technical objectives on schedule and within cost.

Minor Weakness: A weakness that is sufficiently worrisome to note and can be brought to the attention of Proposers during debriefings, but is not a discriminator in the assessment of risk.

Note: Findings that are considered "as expected" are not documented in the Form C.

TMC Evaluation

TMC Evaluation Panel Other Considerations

- Programmatic risks may be assessed but are not included in the TMC risk rating.
  - Examples include but are not limited to: stability and reliability of proposed partners and their contributions, and environmental assessment approvals.
- The panel evaluating the "TMC Feasibility of the Proposed Investigation Implementation" will provide comments to NASA regarding the extent to which the proposed investigation provides career development opportunities to train the next generation of engineering and management leaders.
  - While these comments will not be considered in the evaluation, they may be considered during selection.

TMC Evaluation

TMC Evaluation Cost Analysis

- Initial cost analyses are accomplished on the basis of information provided in the proposals (e.g., consistency, completeness, basis of estimate, contributions, use of full cost accounting, maintenance of reserve levels, cost management).
- One or more cost models are utilized to validate the proposed cost.
- Implementation threats are identified.
- Cost threat impacts to the proposed unencumbered reserves are assessed (refer to TMC Cost Threat Matrix in next slide). The remaining unencumbered reserves are compared to the minimum required in the PEA.
- The entire panel participates in Cost deliberations. All information from the entire evaluation process is considered in the final cost assessment.
- Cost findings are documented under the Cost Factor on the Form C.
- The panel is polled for Cost Risk Rating.

TMC Evaluation

TMC Evaluation Cost Analysis: Cost Threat Matrix

The *likelihood* and *cost impact*, if any, of each weakness is stated as "This finding represents a cost threat assessed to have an Unlikely/Possible/Likely/Very Likely/Almost Certain likelihood of a Very Minimal/Minimal/Limited/ Moderate/Significant/Very Significant cost impact being realized during development and/or operations, which results in a reduction from the proposed unencumbered reserves."

- The *likelihood* is the probability range that the cost impact will materialize.
- The *cost impact* is the current best estimate of the range of costs to mitigate the threat.

The cost threat matrix defines the adjectives that describe the *likelihood* and *cost impact*.
The minimum cost threat threshold is $1M.

			Cost Impact (CI) % of PI-Managed Mission Cost to complete Phases B/C/D or % of Phase E not including unencumbered cost reserves or contributions					
	Likelihood of Occurrence	**Weakness**	**Very Minimal** 0.5% < CI ≤ 2.5% ($0M < CI ≤ $0M) 1% < CI ≤ 2.5% ($0M < CI ≤ $0M)	**Minimal** 2.5% < CI ≤ 5% ($0M < CI ≤ $0M) 2.5% < CI ≤ 5% ($0M < CI ≤ $0M)	**Limited** 5% < CI ≤ 10% ($0M < CI ≤ $0M) 5% < CI ≤ 10% ($0M < CI ≤ $0M)	**Moderate** 10% < CI ≤ 15% ($0M < CI ≤ $0M) 10% < CI ≤ 15% ($0M < CI ≤ $0M)	**Significant** 15% < CI ≤ 20% ($0M < CI ≤ $0M) 15% < CI ≤ 20% ($0M < CI ≤ $0M)	**Very Significant** CI > 20% (CI > $0M) CI > 20% (CI > $0M)
Likelihood (L, %)	Almost Certain (L > 80%)							
	Very Likely (60% < L ≤ 80%)							
	Likely (40% < L ≤ 60%)							
	Possible (20% < L ≤ 40%)							
	Unlikely (L ≤ 20%)							

Note: Each "$0M" is converted to dollars according to the associated percentage depending on the proposed PIMMC.

TMC Evaluation Cost Analysis: Cost Risk Definitions (1 of 4)

The three criteria below are indicators of Cost Risk. Evaluators must consider these criteria and other relevant information (e.g., cost model applicability, uncertainty of the cost models error bars, effect of cost issues that fall below the minimum cost threat threshold, likelihood of cost impacts, mitigating factors such as major strengths, etc.) together with their judgement in determining the appropriate Cost Risk for a particular investigation.

Three criteria are considered for the determination of the Cost Risk for a proposed investigation; 1) The level of unencumbered reserves after any reduction by TMC identified cost threats; 2) The comparison of proposed cost with the TMC Base Independent Cost Estimate considering the appropriate error bars; and 3) The proposed cost, including reserves, supported by material in the proposal.

Appropriate Cost Reserves are defined as the minimum unencumbered reserves required by the PEA, or higher as judged by the TMC evaluation panel based on the justification provided by the PI (Principal Investigator).

Unencumbered cost reserves higher than the minimum PEA requirement may be necessary for some investigations, such as those requiring specific technology maturation.

TMC Evaluation Cost Analysis: Cost Risk Definitions (2 of 4)

Low Risk

- No cost threats have been identified by the TMC evaluation panel that reduce the proposed unencumbered cost reserves below the Appropriate Cost Reserves.
- The proposed investigation cost and the cost of all modelled lower Work Breakdown Structure (WBS) levels are greater than or equal to the lower bounds of the TMC Base Independent Cost Estimate error bars.
- The proposed investigation cost estimate is very well supported by the information in the proposal.

Low/Medium Risk

- No cost threats have been identified by the TMC evaluation panel that reduce the proposed unencumbered cost reserves below the Appropriate Cost Reserves.
- The proposed investigation cost and the cost of most modelled lower WBS levels are greater than or equal to the lower bounds of the TMC Base Independent Cost Estimate error bars.
- The proposed investigation cost estimate is well supported by the information in the proposal.

TMC Evaluation Cost Analysis: Cost Risk Definitions (3 of 4)

Medium Risk

- Cost threats have been identified by the TMC evaluation panel that reduce the proposed unencumbered cost reserves below the Appropriate Cost Reserves.
- The proposed investigation cost or the cost of most modelled lower WBS levels are greater than or equal to the lower bounds of the TMC Base Independent Cost Estimate error bars.
- The proposed investigation cost estimate is mostly supported by the information in the proposal.

Medium/High Risk

- Cost threats have been identified by the TMC evaluation panel that reduce the proposed unencumbered cost reserves below the Appropriate Cost Reserves.
- The proposed investigation cost or the cost of most modelled lower WBS levels are lower than the lower bounds of the TMC Base Independent Cost Estimate error bars.
- The proposed investigation cost estimate is not well supported by the information in the proposal.

TMC Evaluation Cost Analysis: Cost Risk Definitions (4 of 4)

High Risk

- Cost threats have been identified by the TMC evaluation panel that reduce the proposed unencumbered cost reserves significantly below the Appropriate Cost Reserves.
- The proposed investigation cost and the cost of most modelled lower WBS levels are significantly lower than the lower bounds of the TMC Base Independent Cost Estimate error bars.
- The proposed investigation cost estimate is not supported by the information in the proposal.

TMC Evaluation

Potential Major Weaknesses (PMWs) Clarification Process

Section 7.1.1 of the SALMON-3 AO states that "Proposers should be aware that, during the evaluation and selection process, NASA may request clarification of specific points in a proposal; if so, such a request from NASA and the proposer's response must be in writing."

Subject to feedback from the EVM-3 AO evaluation, which will do this for the first time, the current plan is the following:

Proposers will be allowed up to six pages (with some restrictions) for clarifications of PMWs associated with the Intrinsic Science Merit of the Proposed Investigation, and the Experiment Science Implementation Merit and Feasibility of the Proposed Investigation evaluation criterion, and **up to six pages (with some restrictions) for clarifications of PMWs associated with the TMC Feasibility of the Proposed Investigation Implementation evaluation criterion**.

These clarifications may include text, tables and figures to address the PMWs and to provide additional information.

Please note that the PMWs clarification process is a significant modification from the process previously utilized for other Step 1 or Single-Step evaluations.

PMWs Clarification Process: Requirements (1 of 2)

Clarifications Responses must conform to the following requirements:

Requirement 1: Proposers shall submit only two Clarification Response Documents, i.e., one for Intrinsic Science Merit of the Proposed Investigation, and Experiment Science Implementation Merit and Feasibility of the Proposed Investigation, and one for the TMC Feasibility of the Proposed Investigation Implementation.

Requirement 2: The Clarification Response Document shall be a single unlocked (e.g., without digital signatures) searchable Adobe Portable Document Format (PDF) file, composed of the response text, figures, and/or tables. Images (e.g., figures and scans) shall be converted into machine-encoded text using optical character recognition. Animations shall not be included. Links to materials outside of the response are not permitted. Do not insert any comment fields.

Requirement 3: The Clarification Response Document shall be presented in 8.5 x 11 inch paper (or A4). Text shall not exceed 5.5 lines per vertical inch and page numbers shall be specified. Margins at the top, both sides, and bottom of each page shall be no less than 1 inch if formatted for 8.5 x 11 inch paper; no less than 2.5 cm at the top and both sides, and 4 cm at the bottom if formatted for A4 paper. Type fonts for text, tables, and figure captions shall be no smaller than 12-point (i.e., no more than 15 characters per horizontal inch; six characters per horizontal centimeter). Fonts used within figures shall be no smaller than 8-point.

PMWs Clarification Process: Requirements (2 of 2)

Requirement 4: The Clarification Response Document shall not exceed a total of six pages per criteria, i.e., six for Experiment Science Implementation Merit and Feasibility of the Proposed Investigation, and six for the TMC Feasibility of the Proposed Investigation Implementation. Text, table(s) and figure(s) are permitted, however all material shall be within the six page limit per criteria and limitations in Requirement 3.

Requirement 5: The Clarification Response Document shall not contain International Traffic in Arms Regulations (ITAR), Export Administration Regulations (EAR), or classified material.

Requirement 6: Each PMW shall be addressed and each clarification response labelled with the PMW number provided. Each PMW clarification response shall only contain information relevant to the PMW.

Requirement 7: The proposers are free to provide any additional information on any criteria or requirements relevant to the proposed investigation, e.g., for TMC Feasibility of the Proposed Investigation Implementation, advances in proposed technologies since proposal submission. However, this response together with the PMW clarification responses shall fulfill requirements above and not exceed the six total page limitation per Clarification Response Document.

Requirement 8: In support of each PMW clarification response, proposers shall not provide more than two references; references are restricted to peer reviewed literature. In support of any additional information response, proposers shall not provide more than three additional references; references are restricted to peer reviewed literature. Proposers shall not provide URLs with any of the responses.

TMC Evaluation

TMC Risk Ratings

TMC Evaluation: to assess the likelihood that the submitted investigations' technical and management approaches can be successfully implemented as proposed, including an assessment of the likelihood of their completion within the proposed cost and schedule.

Based on the narrative findings, each proposal is assigned one of three risk ratings, defined as follows:

- **LOW Risk**: There are no problems evident in the proposal that cannot be normally solved within the time and cost proposed. Problems are not of sufficient magnitude to doubt the proposer's capability to accomplish the investigation well within the available resources.
- **MEDIUM Risk**: Problems have been identified, but are considered within the proposal team's capabilities to correct within available resources with good management and application of effective engineering resources. Investigation design may be complex and resources tight.
- **HIGH Risk**: One or more problems are of sufficient magnitude and complexity as to be deemed unsolvable within the available resources.

Note: Only Major Findings are considered in the risk rating.

References

GDC Acquisition Homepage

The GDC Acquisition Homepage is found at https://lws.larc.nasa.gov/gdc

GDC Library

All reference documents are available on the same web site at
https://lws.larc.nasa.gov/gdc/programlibrary.html

GDC PEA

The GDC PEA can be accessed from the NSPIRES Website at http://nspires.nasaprs.com/

Questions

Answers to previously submitted questions:

https://lws.larc.nasa.gov/gdc/faq.html

(*Questions & Answers* tab on SOMA's GDC Acquisition Homepage)

Questions accepted up to 21 days before the proposal due date [PEA Sec. 9]

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