

Dynamic Neutral Atmosphere-Ionosphere Coupling (DYNAMIC) Solicitation

Pre-Proposal Conference
Technical, Management, and Cost (TMC)

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Glossary

AO	Announcement of Opportunity
GDC	Geospace Dynamics Constellation
NOI	Notice of Intent
PMW	Potential Major Weakness
PPC	Pre-Proposal Conference
RPL	Rideshare Payload
S&MA	Safety & Mission Assurance
SPA	Secondary Payload Adapter
TMC	Technical, Management, and Cost
TRL	Technology Readiness Level
VADR	Venture-Class Acquisition of Dedicated and Rideshare

References Annotation

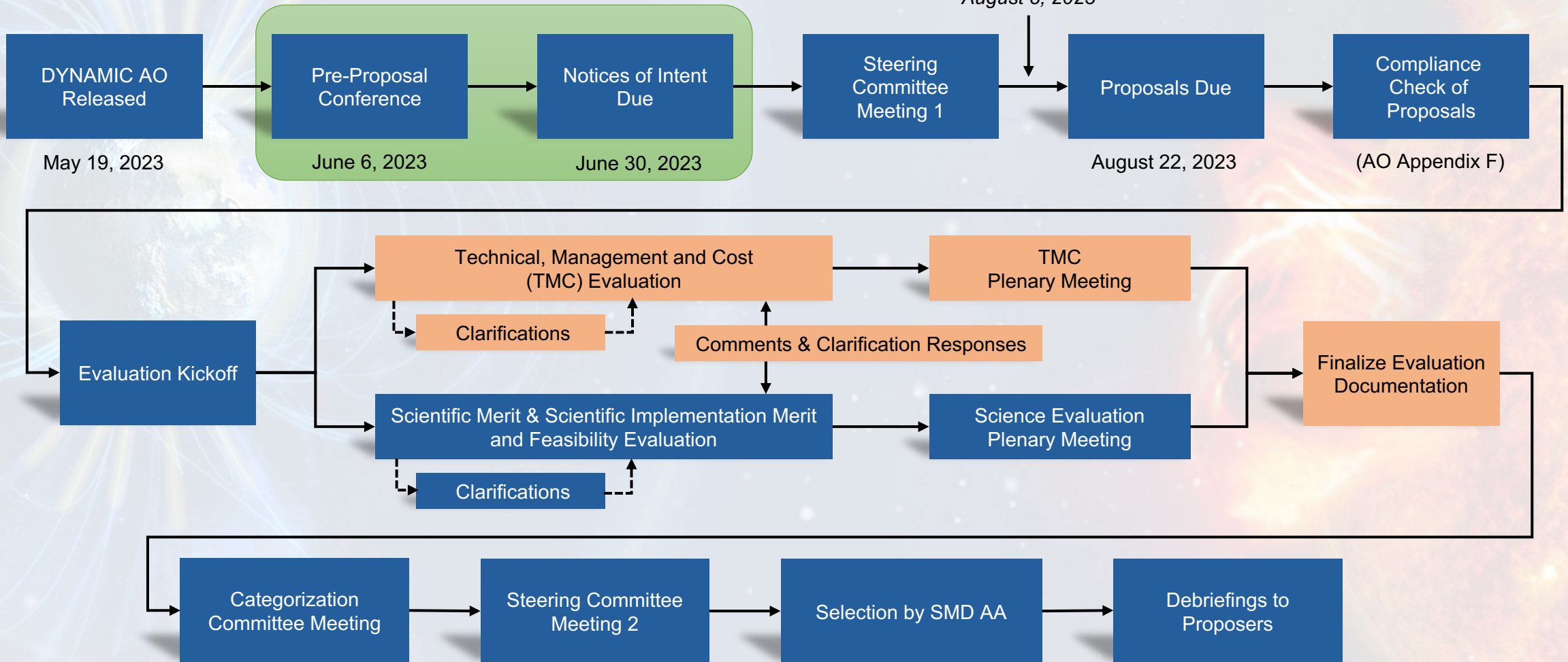
- Discussions may reference relevant solicitation documents/materials
 - AO §#.# AO Section
 - AO Req. ## AO Requirement
 - §#.# Proposal Section (section within AO Appendix B)
 - EP ## AO Evaluation Plan slide
 - PL XYZ Program Library document
 - PPC XYZ ## Pre-Proposal Conference presentation, slide
 - Q&A X-## AO Questions & Answers entry

The background is a composite of three space-related images. On the left, Earth is shown with its blue and white magnetic field lines extending into space. The center features a vast field of stars of various colors and sizes against a dark blue background. On the right, a close-up of the Sun's surface is visible, showing bright orange and yellow flames and solar flares.

TMC Evaluation

Proposal Evaluation Flow

Last day to submit questions
August 8, 2023



TMC Evaluation Overview

Proposal Evaluation Criteria

- A. Science Merit of the Proposed Investigation
- B. Science Implementation Merit and Feasibility of the Proposed Investigation
- C. TMC Feasibility of the Proposed Mission Implementation**
- D. Programmatic Value of the Proposed Investigation

Weighting: The first criterion is weighted approximately 35%; the second and **third criteria are weighted approximately 30%** each; the fourth is weighted approximately 5%.

- The Technical, Management and Cost (TMC) panel evaluates the TMC Feasibility of the Proposed Mission Implementation, and produces Form C.
- The DYNAMIC Evaluation Plan provides important information on the Evaluation processes and requirements (see Acquisition page).

TMC Evaluation Factors

TMC evaluation factors are presented in §7.2.4, “TMC Feasibility of the Proposed Mission Implementation”

The factors generally follow those of the template AO.

- 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.

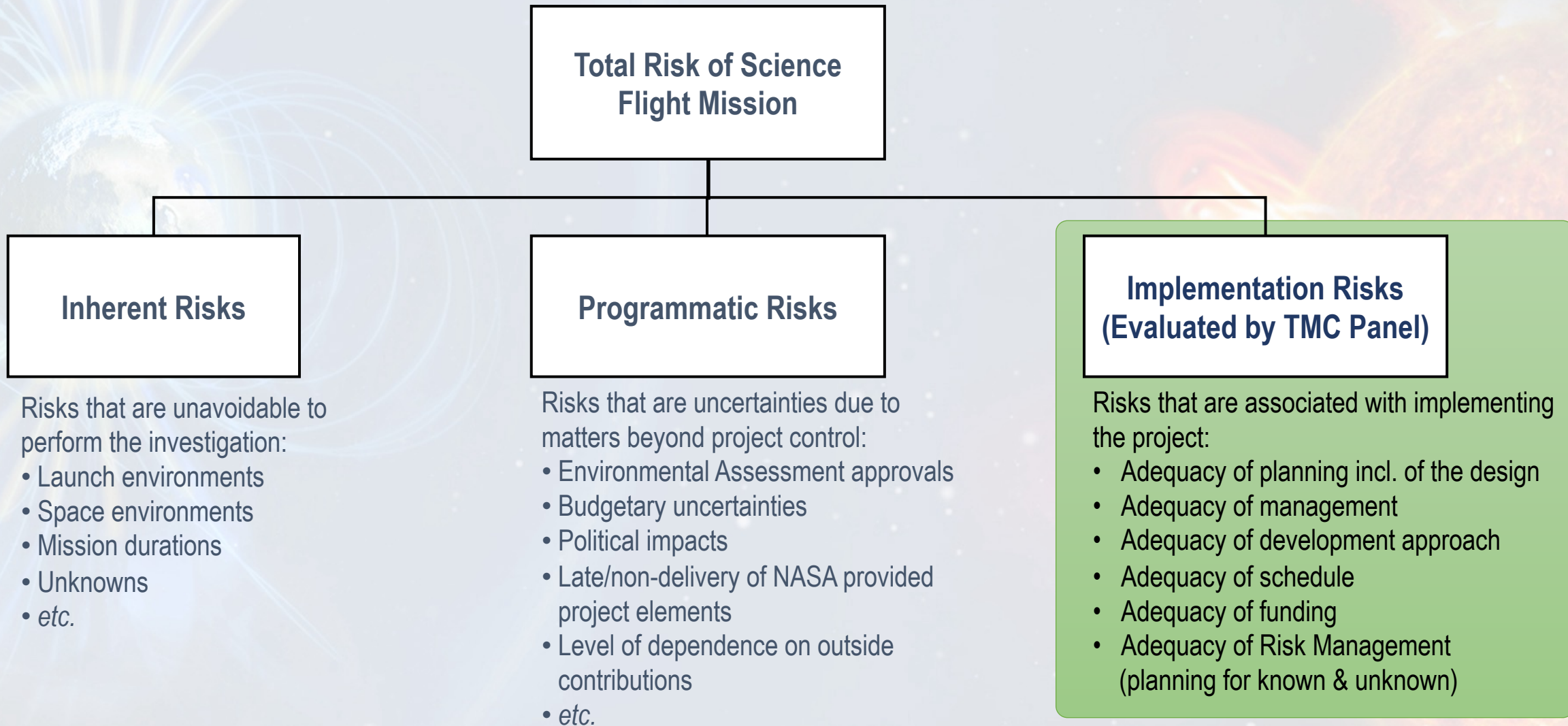
TMC Evaluation Purpose and Principles

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 project cost and schedule.

Basic Principles:

- It is assumed that the proposer is the expert on their 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.

TMC Evaluation: What is Evaluated?



Principles for Evaluation [PE 11-19]

- All proposals are to be treated fairly and equally.
- Merit and Risk are to be assessed on the basis of the material provided in the proposal and through the clarification process.
- Evaluation Ratings shall reflect the written strengths and weaknesses.
- Everyone involved in the evaluation process is expected to act in an unbiased objective manner; advocacy for particular proposals is not appropriate.

General Evaluation Ground Rules [PE 11-19]

- All proposals are evaluated to uniform standards established in the DYNAMIC AO, and without comparison to other proposals.
- All evaluators are experts in the areas that they evaluate.
- Specialist Evaluators (to provide special technical expertise to the TMC Panel) may be used based on need for expertise in a specific technology that is proposed.
- Proposals are based on pre-Phase A concepts; TMC risk assessments give appropriate benefit of the doubt to the Proposer.

TMC Evaluation Products: Findings [EP 44]

- **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.
- **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 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.
- **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 on the Form C.

TMC Evaluation Products: Risk Ratings [EP 45]

Based on the narrative findings, each proposal will be 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.

TMC Envelope Concept

Envelope: Contains all TMC Resources available to handle known and unknown development problems that occur. Includes schedule and funding reserves; reserves and margins on physical resources such as mass, power, and data; descope options; fallback plans; and personnel.

Low Risk: Required resources fit well within available resources.



Medium Risk: Required resources just barely inside available resources.



High Risk: Required resources DO NOT fit inside available resources.



TMC Panel Other Considerations [EP 37]

- The TMC panel can write comments to the Selection Official on topics relevant to programmatic considerations.
- While these comments will not be considered in the evaluation, they may be considered during selection.
- Examples include but are not limited to:
 - Size and nature of contributions,
 - Fraction of PIMMC expended before KDP-C,
 - The managerial and spaceflight experience of the PI, and whether appropriate mentoring and support tools are in place,
 - Extent to which the proposed investigation provides career development opportunities to train the next generation of engineering and management leaders.
 - For DYNAMIC this may also include flexibility to launch configuration.



Highlights of the DYNAMIC AO

DYNAMIC AO Introduction

Investigations proposed in response to this solicitation must

- Support NASA's Heliophysics science goals, the goals and objectives of the STP Program, and address the decadal-recommended DYNAMIC science questions (evaluated by Science Panel)
- Be implemented by Principal Investigator (PI) led project teams
- Achieving the science objectives of the investigation must require the provision of a spaceflight mission [AO §5.1.1] and the proposal must be for a complete spaceflight project [AO §5.2.1].

Proposed investigations will be evaluated and selected through a two-step competitive process

- This is Step 1 of a 2-step process.
- Step 2 Concept Studies will be funded at \$2M if selected. [AO §5.6.2]
- However, if warranted by the evaluation process, NASA reserves the right to select through a single step.

DYNAMIC Highlights

- Unadjusted AO Cost Cap: \$250M (FY23) not including access to space or contributions. [AO §5.6.1]
- Two potential sources of Adjustments to the AO Cost Cap
 - Auroral Imager incentive +\$10M (cap increase) [AO §5.6.1]
 - NSN per-minute/per-pass fees if use of SCaN services is proposed (cap decrease) [AO §5.2.6.3]
 - If use of SCaN resources is not proposed, all ground station costs must be part of the PIMMC.
 - Cost table template (Table B3) includes rows for showing the Adjusted AO Cost Cap calculation.
- Delivery date to launch integration no later than 31 December 2028. [AO Req. 102]
- No option for technology demonstration opportunities (TDO). [AO §5.2.4]
- Minimum unencumbered cost reserves against the cost to complete: 25% for Phases B/C/D and 15% for Phase E. [AO Req. 69, 70]

Accommodation of Auroral Imager

- The *Auroral Imager Accommodation Parameter and Measurement Capabilities* document in the Program Library provides preliminary characteristics [PL Program 7.]
 - Accommodation parameters are considered conservative envelopes (not-to-exceed values).
 - Where parameters are not specified, proposals can list their assumptions.
- The page allocation increases by 2 pages in Sections D-E and 1 page in Sections F-G for proposals that exercise the option.
- Related requirements
 - AO Req. 22. If the proposal exercises the Auroral Imager option, the proposal shall include in the mission design, mission operations concept, and flight system concept discussions of the accommodation, integration and operations of this instrument.
 - AO Req. 24. If the proposal exercises the Auroral Imager option, the proposal shall include in the development approach a discussion of the accommodation and integration of this instrument within schedule and cost constraints, and shall include in their project schedule the key milestones of that integration.
 - Impacts Section F, G requirements where applicable.

AO-Provided Access to Space

- PI-provided access to space is not allowed.
- AO-provided access to space is Rideshare on an SMD-selected Government Primary launch
- The service provides for one or two ESPA-Grande ports with tailored interface specifications
 - See PL AO Ref 5.a, 5.b
 - No radioactive materials of any type are allowed.
 - Charge(s) against the PIMMC for any mission-unique services beyond the standard options [AO Req. 97, PL AO Ref 5.a]
- Proposal teams do not select their launch injection orbit [AO Req. 99 and B-34, PL AO Ref 5.a]
- The AO gives launch schedule expectations relative to the GDC mission for the purpose of science investigation planning [AO Req. 13 and 14]
- Proposals must include a storage plan [AO Req. 103 and 104, §J.17]
- Flexibility to launch configuration can be of programmatic interest
 - If applicable, possibility for dedicated launch described in §J.18 [PL AO References 5.c]

Further details in the access to space presentation [PL 10]

AO-defined Category and Class

- NASA had designated the DYNAMIC project as Category 3 (per NPR 7120.5F) Class D (per NPR 8705.4A)
- The DYNAMIC project is required to meet the requirements for safety, reliability, and mission assurance in SPD-39 *Science Mission Directorate Policy: SMD Standard Mission Assurance Requirements For Payload Classification D* [PL Programs 3.b]
- Details on SPD-39 in the Mission Assurance presentation [PPC 09 *Safety & Mission Assurance*]

AO Req. 27

- The proposal shall indicate any expected deviations from the recommended requirements in SPD-39 and in Appendix D of NPR 8705.4 for the payload class specified in AO §4.1.4.
- Tailoring below SPD-39 shall not be proposed, even for individual flight elements within a constellation.
- Proposals shall discuss any enhancement (*i.e.*, tailoring up) of the safety and mission assurance requirements necessary and appropriate for the proposed mission lifetime.

Note that the AO specifies neither a floor nor a ceiling for the DYNAMIC mission lifetime. Projects are expected to enhance (*i.e.*, tailor up) the S&MA requirements as necessary and appropriate for their proposed mission lifetime. [AO §4.1.4]

Earned Value Management

Earned Value Management

- AO §4.6.2 provides additional explanation of EVM over previous AOs [also see Q&A C-3, C-4].
- To level the playing field, a reimbursement can apply for projects with a Life Cycle Cost (LCC) between \$150M and \$250M (RY), which for the purposes of this AO is assumed to correspond to a PIMMC between \$120M to \$200M (FY23)
- The program will provide a total reimbursement of up to \$1.5M (FY23) for the difference in cost between:
 - implementation of validated EVM on contracts over \$20M per the NFS, and
 - application of the performance measurement basic best practices referenced in the *Guidance and Expectations for Small Category 3, Risk Classification D (Cat3/ClassD) Space Flight Projects with Life-Cycle Cost Under \$150M* document.
- If applicable, a justified difference in cost can be shown as part of the Enhanced PIMMC.

Multiple-Builds and Constellations

- An additional 4 pages total are allowed across D-H if at least one multiple-build instrument or spacecraft is proposed.
- Factors C-4 and C-5 include additional wording
 - *“If multiple builds are proposed, this factor includes the ability to build, test, and integrate the required number of flight units with repeatable quality and performance standards on the required schedule, the system 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 factor also includes assessment of elements such as the relationship of the work to the project schedule, the project element interdependencies including the resiliency of the production and test schedule to problems appearing in multiple-unit builds if applicable, the associated schedule margins, and an assessment of the likelihood of meeting the proposed delivery readiness date”*
 - *“the adequacy of the approach used to develop the estimated cost (including how multiple unit builds are costed)”*

Multiple-Builds and Constellations (continued)

- Examples of proposal topics that can be affected by a multiple-build mission, if applicable:
 - Systems Engineering and Software Engineering approaches: one of the mission-unique aspects [AO Req. 28]
 - I&T plan: any tools used to facilitate builds, such as special facilities, additional GSE, special staffing approach, and/or automation [AO Req. B-43]
 - Schedule: any early risk-reduction testing (*e.g.*, TRL-6 demonstration; use of prototypes; EMs or ETUs for production planning; *etc* [AO Req. B-44]
 - Management: how the team will be organized for the manufacture, test and calibration of multiple flight units [AO Req. B-46]
 - Risk: associated production risks, including impacts to schedule, facilities, and staffing; and potential mitigations [AO Req. B-48], *etc.*
 - Cost: non-recurring versus recurring portions of the cost, BOE for multiple-unit builds [AO Req. B-53, B-54]
- The template for Table B3 correspondingly includes additional rows for non-recurring versus recurring costs.

DYNAMIC Page Count Limits [AO Table 4]

- Sections D-E are limited to 29 pages, plus
 - Up to one foldout or two pages for the Science Traceability Matrix
 - 2 pages for each non-identical instrument (including Auroral Imager if applicable)*
- Sections F-G are limited to 15 pages, plus
 - Up to two foldouts for the schedule
 - 2 pages for each non-identical flight element (spacecraft)*
 - 1 page for accommodation of the Auroral Imager, if applicable*
- Section H is limited to 5 pages plus
 - Table B3 foldout(s) or page(s)
- In addition, multiple-build proposals can add up 4 pages across D-H

***Total additional pages for non-identical instruments and spacecraft limited to 10**

DYNAMIC Page Count Limits Examples

- Examples of page count limit calculations are notional for the sake of clarification
- Base total for D-H is $29+15+5 = 49$; plus STM F/O, 2 + Schedule F/O and Table B3

	Example 1	Example 2	Example 3
Concept	1 spacecraft carrying 2 instruments plus the Auroral Imager	2 identical spacecraft carrying 2 instruments each	1 Smallsat with 2 instr., plus 3 Cubesats with 1 other instr. and 3 different Cubesats with 1 instr.
Sections D-E	$29 + 3 \times 2 = 35$ + STM F/O	$29 + 2 \times 2 = 33$ + STM F/O	$29 + 4 \times 2 = 37$ + STM F/O
Sections F-G	$15 + 1 \times 2 + 1 = 18$ + 2 Schedule F/O	$15 + 1 \times 2 = 17$ + 2 Schedule F/O	$15 + 3 \times 2 = 21$ + 2 Schedule F/O
<i>Total add'l pages D-E</i>	$3 \times 2 + 1 \times 2 + 1 = 9$ <i>below limit</i>	$2 \times 2 + 1 \times 2 = 6$ <i>below the limit</i>	$4 \times 2 + 3 \times 2 = 14$ <i>-> apply the limit of 10</i>
Section H	5 + TableB3	5 + TableB3	5 + TableB3
<u>Multiple builds D-H</u>	<u>0</u>	<u>4</u>	<u>4</u>
Total D-H	$49 + 9 + 0 = 58$ + STM, Schedule, and Table B3	$49 + 6 + 4 = 59$ + STM, Schedule, and Table B3	$29 + 10 + 4 = 66$ + STM, Schedule, and Table B3



AO Simplification and Updates

AO Simplification Overview

- To reduce the workload on investigation teams generating Pre-Phase A proposals, NASA SMD has changed some discussion requirements to be either deferred to Step 2 or simplified.
- Proposal evaluators will be directed to perform the evaluation based on these requirement deferrals, simplifications, and page reductions.
- The same simplifications seen in recent AOs such as Heliophysics Small Explorers 2022 are also implemented for DYNAMIC.
- Deferral of requirements is meant to simplify proposal writing – not to waive any technical requirements. [AO §1.1, AO Req. B-52, Q&A T-6, C-2]

Page count limits reflect the simplified requirements. [AO Table 4]
TMC Evaluation Criteria rewording reflects simplified requirements. [AO §7.2.4]

AO Template Simplification Details

Requirements simplified include:

- No paraphrasing of NASA Procedural Requirements (NPRs) needed; only any tailoring or waivers. [AO Req. 29, 30, §J.15]
- Systems Engineering and Software Engineering: only aspects unique to the mission. [AO §5.2.3, §F.3, AO Req. 28 and B-40]
- Decision-making authority, teaming arrangement and responsibilities discussion brief. No need for explanation of traditional roles for key personnel, only mission-unique roles and responsibilities [Req. 47, 48, B-46, B-47]
- Schedule: two schedule foldouts do not count against the page limit instead of three; an Integrated Master Schedule file is not required, only a Microsoft Excel table of dates [AO Table 4, §F.6, AO Req. B-44, B-45]
- Tables for: Project risk and potential mitigations; Descopes; Basis of Estimate [Req. B-48, B-49, B-53]
- Brief discussions for cost: methodologies, assumptions, reserves, risk [AO §5.6.3, §H, AO Req. 68, B-52, B-B-56]
- No 'exploded diagram' in the appendix for Summary of Proposed Program Cooperative Contributions. International Participation reduced to tables and a brief narrative. [§J.4, J.5]
- Heritage Appendix page count limit is 15 pages including any page(s) for a Classified Appendix. [§J.12, §J.13]
- Master Equipment List (MEL) requires only a PDF copy of the Excel version. [§J.11, Q&A P-2]

AO Template Deferral Details

Discussions deferred to Step 2 include:

- Science Enhancement Option (SEO) [AO §5.1.5] and Student Collaboration [AO §5.5.2]
- RF maximum channel bandwidth [AO §5.2.6.2, AO Req. 35]
- Critical events coverage [AO §5.2.7, AO Req. 39]
- Mission-unique adaptations to AMMOS [AO §5.2.9, AO Req. 41]
- System Protection Plan [AO §5.2.10, Req. 42]
- Schedule-based end-to-end components of the Data Management Plan [AO Req. B-25]
- Names and resumes for Project Manager (PM) and Project Systems Engineer (PSE) [AO §5.3, §G, §J.3, Req. 45, 46]
- Sources of estimate error and uncertainty in the proposed cost and management approaches for controlling cost growth [AO Req. 68]
- Any independent cost estimates performed outside the proposing organizations
- Cost in Real Year dollars
- Description of cost management tools
- Discussion of Limiting the Generation of Orbital Debris and End of Mission Spacecraft Disposal Requirements [§J.8, Req. B-70, B-71, B-72]

Other AO Changes

- Space Communications and Navigation (SCaN) office [AO § 5.2.5]
 - Updated AO section working and updated Near Space Network (NSN) User's guide in the Program Library [PL 7.d]
 - Channel bandwidth limits apply at S-band and at X-band (see PL 7.b *Available Spectrum and Channel Limits By Allocated Service*). The use of K/Ka-band is preferred for high-rate data downlink.
 - See AO Req. 36-38 for specific costing requirements.
- Fraction of Cost incurred before KDP-C [AO 5.6.1, AO Req. 64]
 - The 25% maximum fraction of cost before KDP-C has been removed as a specific required limit.
 - Project costs by phase are still expected to be consistent with the scope of work required in each project phase per NPR 7120.5. In particular, the project remains in Formulation and Technology Completion until successful KDP-C provides approval for transitioning into Implementation.
- Contribution Limit [AO §5.6.7]
 - The size and nature of contributions will be assessed as programmatic factors outside of the TMC,
 - Goal: ensure a preponderance of NASA interest in the investigation, as well as ensure that investigations of roughly comparable scope are proposed for purposes of equitable competition.
- No photographs allowed in any of the resumes [AO Req. B-65]
- Additional guidance provided for aligning WBS breakouts with those of the TMC cost validation effort [sH]

Other AO Discussions

DYNAMIC AO Elements discussed in PS Presentation [PPC 05. AO Goals and Objectives #.#]

- Relationship to GDC [AO §2.3, 5.1.2, 5.1.4, 5.4.1, 5.9.4]
- Auroral Imager motivation and impact on baseline science [AO §2.3, 5.1.2, 5.1.4, 5.4.1, 5.6.1, 5.9.5]
- Letters of Support [AO §5.8.3, §J.2]

AO Updates discussed in PS Presentation [PPC 05. AO Goals and Objectives #.#]

- Citizen Science [AO §5.1.6 and 5.4.4, §J.16, Q&A S-6, S-8 through S-17]
- Diversity and Inclusion Plan [AO §5.3.8 and 7.2.3, §J.14]
- Compliance with NASA SPD 41a and the *Heliophysics Division Science Data Management Policy* [AO §4.4, 5.1.3, AO Req. B-25, B-26]

The background is a composite of space-related imagery. On the left, Earth is shown with its magnetic field lines in blue and yellow. In the center, a bright star with a lens flare is visible. On the right, a large, glowing orange and red nebula or star is depicted. The overall scene is set against a dark blue space filled with numerous stars.

Clarification Process

Per DYNAMIC Evaluation Plan
(EP 47-51)

Clarifications Process: Modified from Previous AOs

AO §7.1.1 states “Proposers should be aware that, during the proposal 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. NASA will request clarification in a uniform manner from all proposers.”

In particular, before finalizing the proposal evaluation NASA will request clarification on potential major weaknesses (PMWs) in the A, B, C, and D factors that have been identified in the proposal.

PIs whose proposals have no PMWs will be informed that no PMWs have been identified.

All PIs are allowed the same number of pages for Clarifications, including those who have no PMWs.

The full set of clarification responses to the factors above will be considered by the Science Panel and the Technical Management and Cost (TMC) panel. Only the responses will be provided to the other panel but not the PMWs.

Proposers will have at least 48 hours to respond.

Clarification Process Requirements

(1 of 3)

Clarifications Responses must conform to the following requirements:

- Rqmt-1:** The clarification response shall consist of two documents: one Clarification Response Document that addresses the PMWs for the A, B and D factors (combined), and one Clarification Response Document that addresses the PMWs for the C-factors.
- Rqmt-2:** Each 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. Comment fields shall not be inserted.
- Rqmt-3:** The Clarification Response Documents 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.
- Rqmt-4:** For the A-, B-, and D-factors PMWs combined, the Clarification Response Documents shall not exceed eight pages. For the C-factor PMWs, the Clarification Response Documents shall not exceed six pages. Text, table(s) and figure(s) are permitted; however, all material shall be within the page limits specified above and shall abide by limitations in Requirements 2, 3 and 9. Each response file shall not exceed 10MB.

Clarification Process Requirements (2 of 3)

- Rqmt-5:** The Clarification Response Documents shall not contain International Traffic in Arms Regulations (ITAR), Export Administration Regulations (EAR), or classified material.
- Rqmt-6:** The Clarification Response Documents shall label each PMW response with the PMW number provided. Each PMW clarification response shall contain only information specific to the PMW. A clarification response may point back to references in the proposal; however, PMWs' references to locations in the proposal indicate that they have already been evaluated and a re-reference alone does not obligate a re-consideration of those data. References to proposal material is expected to use the proposal section numbers and page number on the proposal page (as opposed to the electronic PDF file page number).
- Rqmt-7:** The Clarification Response Document may include 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 additional information counts against the total page limitation for the Clarification Response Document that contains it.
- Rqmt-8:** The Clarification Response Document shall not include more than two new references in support of any single PMW clarification response or of any single additional information response. All references shall be to peer-reviewed literature, or to full conference proceeding papers (not just abstracts) that are published and accessible. References included in the proposal do not constitute new references. References shall be restricted to those with a publication or release date before the PMW sent date.

Clarification Process Requirements

(3 of 3)

Rqmt-9:

The clarification response may include, outside the two Clarification Response Documents, complete versions of a modified Science Traceability Matrix (STM; Table B1), Mission Traceability Matrix (MTM; Table B2), Total Mission Cost Profile table (Table B3 in Excel format), Master Equipment List (MEL; Table B5 in Excel format), and/or schedule foldout (AO Requirements B-44) and associated table of dates (AO Requirement B-45 in Excel format). These modified fold-out(s)/table(s) shall have modifications clearly marked by the use of a different color font or by a colored-bordered box (labeled “PMW Clarification”). The page-limited Clarification Response Documents shall provide the description of the updates and changes to the modified fold-out(s)/table(s) as text. The complete versions of the modified STM, MTM, Total Mission Cost Profile table, MEL and schedule will not count against the page limit. Any new or other fold-out(s) will each count as two pages against the response page limit.

The background is a composite of three distinct space-themed images. On the left, a blue and white globe of Earth is shown with glowing blue and yellow magnetic field lines radiating from its poles. The center and right portions of the image are filled with a dense field of stars of various colors (blue, white, yellow) against a dark blue and purple nebula. On the right side, there is a close-up, fiery view of a star's surface, showing intense orange and red colors with bright yellow and white spots of activity.

TMC Cost Analysis

Cost Analysis Overview

- Cost is one important element of Technical, Management and Cost (TMC).
- Initial cost analyses are performed on the basis of information provided in the proposals
(*e.g.*, technical baseline, schedule, WBS, cost consistency and completeness, basis of estimate, contributions, use of full cost accounting)
- Cost models for TMC Base Independent Cost Estimates (“base ICE”)
 - Two or more cost models are used to validate the proposed cost for Phases B-D. One or more for Phase E.
 - Cost Models are chosen to be complementary to each other when possible, *i.e.*, different modeling approaches.
 - For Step 2 evaluations, more cost models may be used.
 - Cost model inputs are obtained from the information in the Proposal in order to develop the TMC ICE for the project “as proposed”.
- The TMC identifies implementation threats (weaknesses) and assigns Cost Threats where applicable.
 - Cost Threats are estimates of the cost to mitigate the identified threat and the likelihood that the mitigation will be needed. The total of all Cost Threats above a selected threshold are compared to the proposed unencumbered reserves.
- The entire panel participates in Cost deliberations. All information from the entire evaluation process is considered in the final cost assessment.

Decoding Cost Validation MW

- A cost validation Major Weakness can take the following form:

A sum of cost elements over which the selected cost model(s) are validated against actuals.

Typically can be:

- WBS 1+2+3
- WBS 5
- WBS 6+10
- Total Phases B-D
- Total Phase E

The proposed costs for **WBS X.XX** cannot be validated, as the TMC Base

Independent Cost Estimate exceeds the proposed cost by more than the

error range.

The TMC Base ICE:

- combines the results of the models used (no reserves)
- is performed with the best performing models selected after testing several models against past actuals relevant to this acquisition
- follows the same process, for all proposals in this acquisition
- uses inputs that are based exactly on information in the proposal (*incl. MEL, schedule, heritage, TRL, cost BOE, etc.*)

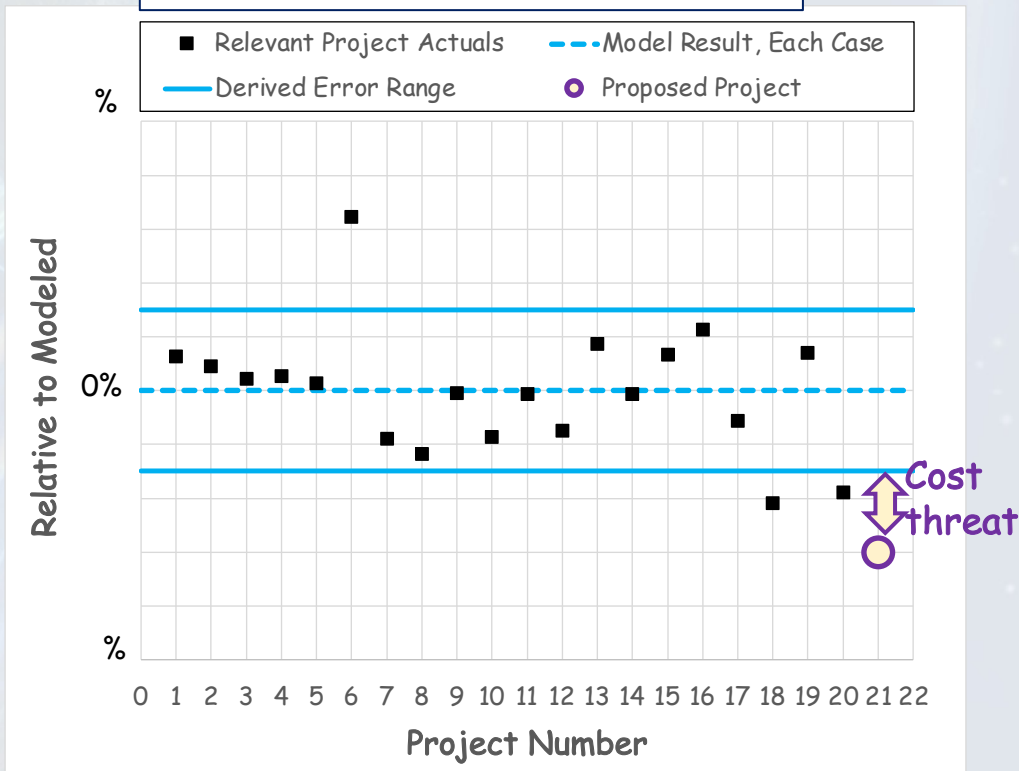
A specific error range is:

- defined prior to the start of proposal evaluations
- derived for this acquisition and each WBS group
- applied to the TMC Base ICE
- based on the combined performance of the selected models on past actuals relevant to this acquisition

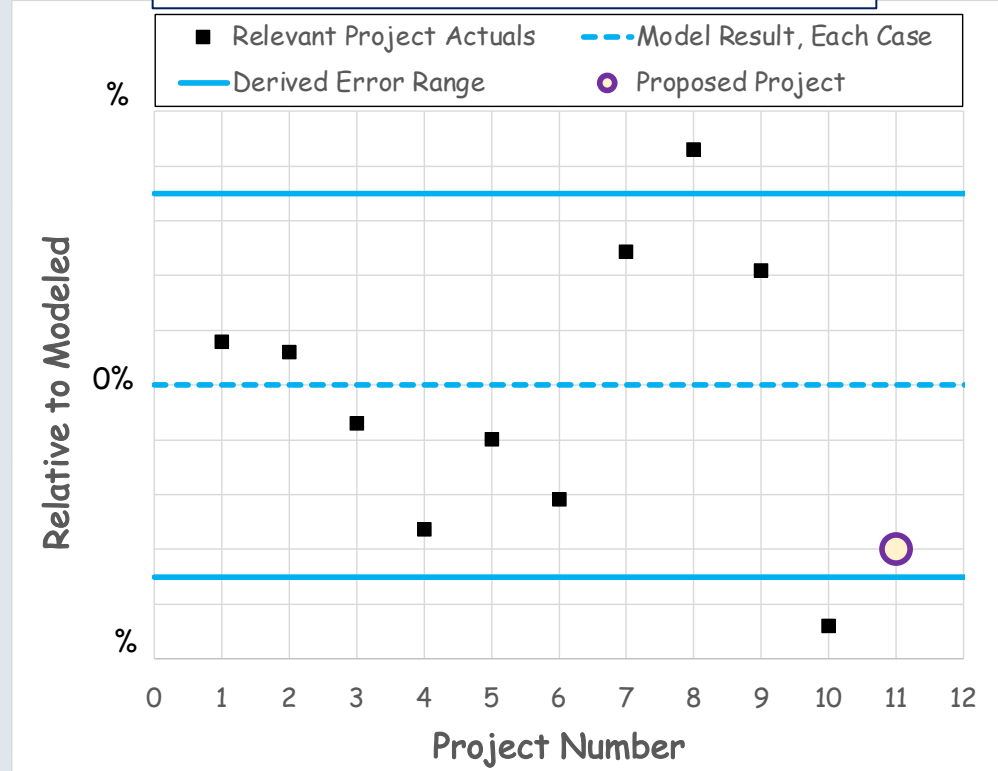
Notional Validation Error Bar Example

- How large a difference from the cost model is needed to trigger a validation finding?
- It depends on how well the chosen cost model combination validates against actuals of relevance, statistically.

Notional Example 1: Validation MW



Notional Example 2: No Validation MW

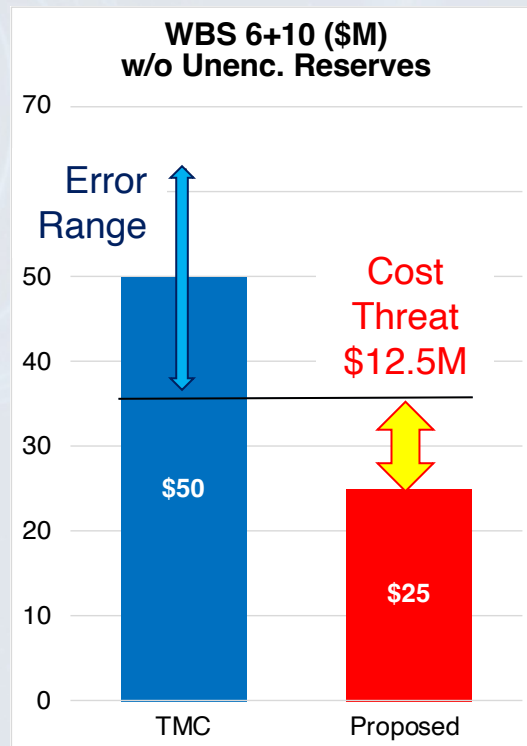


Decoding Cost Validation MW: Example

Notional Proposal A:
validates



Notional Proposal B:
does not validate



- The situation shown in notional example A would not result in a validation finding.
- The situation shown in notional example B would result in the following finding:

“The proposed costs for the sum of WBS 6 and 10 cannot be validated, as the TMC Base Independent Cost Estimate exceeds the proposed cost by more than the error range.”

...followed by a cost threat statement.

Cost Threat Matrix

- The likelihood and cost impact, if any, of each weakness is estimated then stated in terms of Likelihood and Impact categories
 - 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 is \$1M for Phases B/C/D *and \$250K for Phase E.*

Normal black text shows the Phases B/C/D version of the CTM
Italics blue text shows the Phase E version of the CTM

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	Minimal	Limited	Moderate	Significant	Very Significant
		0.5% < CI ≤ 2.5% (\$xM < CI ≤ \$xM) <i>1% < CI ≤ 2.5% (\$xM < CI ≤ \$xM)</i>	2.5% < CI ≤ 5% (\$xM < CI ≤ \$xM) <i>2.5% < CI ≤ 5% (\$xM < CI ≤ \$xM)</i>	5% < CI ≤ 10% (\$xM < CI ≤ \$xM) <i>5% < CI ≤ 10% (\$xM < CI ≤ \$xM)</i>	10% < CI ≤ 15% (\$xM < CI ≤ \$xM) <i>10% < CI ≤ 15% (\$xM < CI ≤ \$xM)</i>	15% < CI ≤ 20% (\$xM < CI ≤ \$xM) <i>15% < CI ≤ 20% (\$xM < CI ≤ \$xM)</i>	CI > 20% (CI > \$xM) <i>CI > 20% (CI > \$xM)</i>
Likelihood (L, %)	Almost Certain (L > 80%)						
	Very Likely (60% < L ≤ 80%)						
	Likely (40% < L ≤ 60%)						
	Possible (20% < L ≤ 40%)						
	Unlikely (L ≤ 20%)						

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

Decoding Cost Threat Statement

- When a Cost Threat is associated with a Major Weakness, the cost threat statement takes the following form:

Estimated likelihood of the cost threat being realized:

- Unlikely: < 20% (weight 10%)
- Possible: 20% - 40% (weight 30%)
- Likely: 40% - 60% (weight 50%)
- Very Likely: 60% - 80% (weight 70%)
- Almost Certain: > 80% (weight 90%)

This finding represents a cost threat assessed to have a [LIKELIHOOD] likelihood of a [IMPACT] cost impact being realized

during development and/or operations, which results in a reduction from the proposed unencumbered cost reserves.

Estimated magnitude of the cost threat relative to the proposed cost (PIMMC in that phase):

- Very minimal: 0.5% – 2.5% (subject to lower \$ threshold)
- Minimal: 2.5% - 5%
- Limited: 5% - 10%
- Moderate: 10% - 15%
- Significant: 15% - 20%
- Very Significant: > 20%

(Can be a specific estimate or middle of the range)

Phase affected by cost threat

- Cost threat impact ranges established separately for Phases B-D and Phase E
- Cost threats evaluated separately against Phases B-D and Phase E
- Impact of cost threats on reserves applied separately to Phases B-D reserves and to Phase E reserves

If realized, cost threats would consume unencumbered cost reserves

- By definition, TMC-identified cost threats are above and beyond the proposed cost basis and the proposed encumbered cost reserves

Decoding Cost Threat Statement: Examples

Example of cost threat statement 1: cost validation Major Weakness

- The cost validation process results in a cost threat of \$12.5M for WBS 6+10. The notional example PIMMC for Phases B-D is \$100M.
- The TMC ponders the case made in the proposal for cost-reducing paradigm and gives further benefit of the doubt to the proposer. The likelihood of this cost threat is estimated in the range 20%-40%.
- The TMC appends the following statement to the cost validation MW:

*This finding represents a cost threat assessed to have a **Possible** likelihood of a **Moderate** cost impact being realized during **development**, which results in a reduction from the proposed unencumbered cost reserves.*

Example of cost threat statement 2: technical Major Weakness

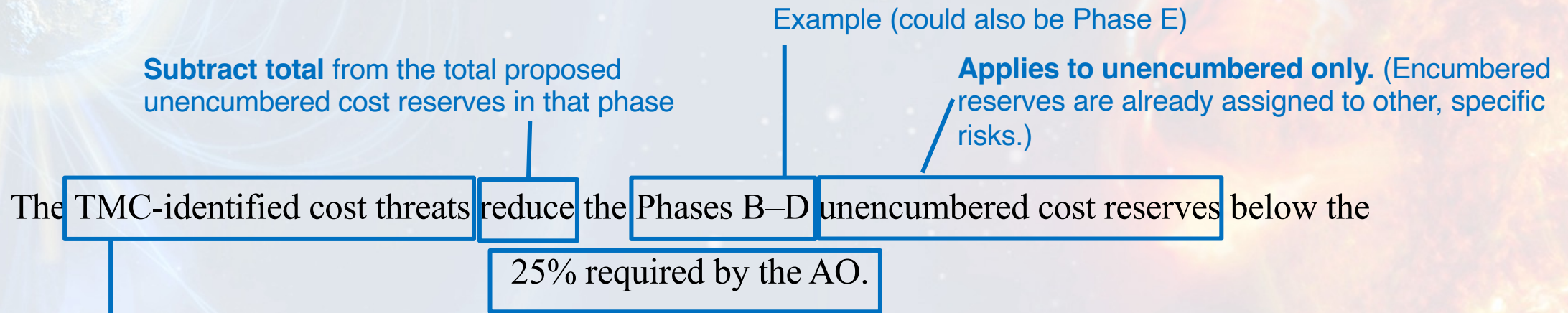
- The TMC considers that the Technology Readiness Level (TRL) is overstated and that it is likely that a TRL development plan will be required before KDP-C. The notional example PIMMC for Phases B-D is \$100M.
- The TMC estimates that the cost for an adequate TRL development plan would be in the range of \$2.5M to \$5M
- The TMC writes the technical MW and appends the following statement:

*This finding represents a cost threat assessed to have a **Likely** likelihood of a **Minimal** cost impact being realized during **development**, which results in a reduction from the proposed unencumbered cost reserves.*

Decoding Summary Statement

Cumulative impact of cost threats

- The Form C “Overall Evaluation/Rationale” Summary could include a statement of the following form.
- When present, this statement informs the risk rating, together with all of the Major Findings. This statement alone does not automatically result in any specific rating.



Total of all identified threats

- weigh impact by likelihood
- add %unencumbered reserves required by the AO (25% for Phases B-D, 15% for Phase E)

TMC compares remaining to AO-required %

- An informational statement
- TMC also assesses the appropriateness of the proposed %unencumbered cost reserves for the specific proposed scope, as justified by the proposal

Decoding Summary Statement: Example

Example of cumulative impact (notional)

- The cumulative impact of the cost threats for this notional example brings the unencumbered cost reserves level from the proposed level of 25% down to 18%.

Likelihood of Occurrence	Weakness	Cost Impact (CI) % of Baseline Mission Cost to complete Phases B-D not including unencumbered cost reserves or contributions					
		Very Minimal \$1.0M < CI ≤ 2.5M (\$1M < CI ≤ \$2.5M)	Minimal 2.5% < CI ≤ 5% (\$2.5M < CI ≤ \$5M)	Limited 5% < CI ≤ 10% (\$5M < CI ≤ \$10M)	Moderate 10% < CI ≤ 15% (\$10M < CI ≤ \$15M)	Significant 15% < CI ≤ 20% (\$15M < CI ≤ \$20M)	Very Significant CI > 20% (CI > \$20M)
Almost Certain (L > 80%)							
Very Likely (60% < L ≤ 80%)							
Likely (40% < L ≤ 60%)	TRL Maturation						
Possible (20% < L ≤ 40%)	Cost Validation						
Unlikely (L ≤ 20%)							

Annotations on the table:
 - A blue arrow points from the 'Minimal' cell to the 'Moderate' cell.
 - A blue arrow points from the 'Moderate' cell to the 'Significant' cell.
 - A blue arrow points from the 'Significant' cell to the 'Very Significant' cell.
 - A blue arrow points from the 'Possible' row to the 'Significant' cell, labeled with $\$3.75M \times 50\% = \$1.9M$.
 - A blue arrow points from the 'Likely' row to the 'Significant' cell, labeled with $\$1.9$.
 - A blue arrow points from the 'Possible' row to the 'Moderate' cell, labeled with $\$3.7$.

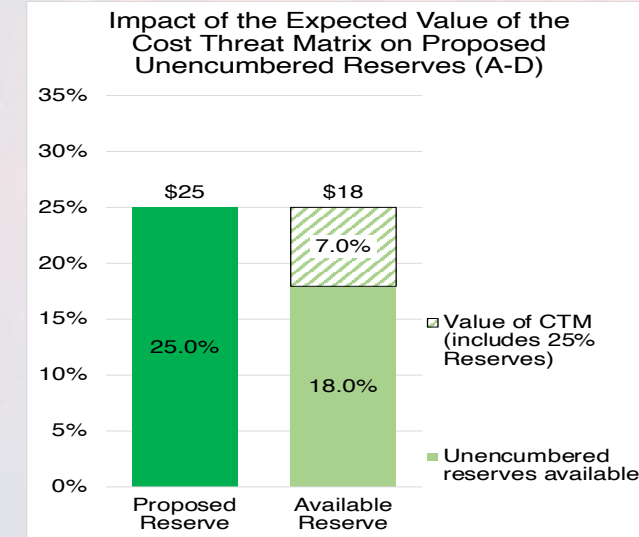
Example for Phases B/D

PIMMC without unenc. reserves	\$100.0
Proposed unenc. reserves %	25%
Proposed unenc. reserves	\$25.0

Total expected cost threat impact	\$5.6
Reserves % on cost threats	25%
Total impact of cost threats	\$7.0

Proposed unenc. reserves minus expected cost threats	\$18.0
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Proposed unenc. reserves minus expected cost threats %	18.0%
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Clarification of Cost PMWs

The Clarification process offers a chance for updating cost information

Information from proposers provided during clarifications may be relevant to cost threat statements associated with PMWs.

For example, the following types of information may be folded into the cost analysis even after the clarifications.

- Past actuals for efforts justified as being similar or otherwise relevant.
- References to past efforts justified as being similar, for which past actuals in CADRe exist.
- Further basis of estimate details, for the specific area(s) identified in the PMW.
- Resolution of inconsistencies or clarification of any misunderstanding affecting cost model inputs.

Benefit of the Doubt in Cost Validation

The TMC Cost Validation process has been geared in several ways towards providing proposers the benefit of the doubt.

1. The inputs to the cost models are derived directly from the descriptions in the proposal, “as proposed”
 - This includes all heritage and TRL level claims.
 - TMC’s independent assessment of technical parameters, if it differs from that of the proposal, is not factored into the Base ICE. It would be reflected in separate findings, with associated cost threats if applicable.
2. Validation error bars are derived specifically for each solicitation. They reflect how well the selected cost model combination performs against actuals of relevance to the solicitation.
 - A cost validation finding major weakness is written only if the proposed cost is outside that error bar.
3. The validation cost threat impact only reflects excursions outside of the error bar (not the full delta between modeled and proposed).
4. The validation cost threat impact is weighted by the cost threat likelihood.
5. Proposal and clarification content can affect the likelihood of the validation cost threat.

Evaluation of the Cost Basis of Estimate

- AO Req. B-53 describes requirement for the Basis of Estimate (BOE):
 - Traceable to the WBS of Table B3,
 - Description of the methodologies and assumptions used to develop the proposed cost estimate,
 - Description of cost reserves that provides insight into their adequacy and robustness,
 - Any additional BOE data to assist the validation of the cost estimates.
- The type of data useful to support a BOE depends on the method used for the cost estimate
 - Example if based on analogy: list heritage cost and rationale for adjustments
 - Example if using parametric model: model name and version, key inputs used with rationale
 - Example if using bottom-up estimates: breakout of labor vs material, FTEs and/or WYEs and average labor rates, list of significant hardware with date and importance to investigation.
- No external independent cost validation estimates are expected in the proposal, nor are they evaluated or considered if submitted.
- TMC's evaluation of the quality of the proposer's basis of estimate is separate from TMC's ICE analysis.
- Different findings can result from the BOE and from the ICE. If the findings are Major, they are both considered during polling for the final risk rating.

Cost Validation Lessons Learned

Proposal teams who do the following tend to better support their proposed cost

- Estimate both schedule and cost iteratively, starting early in proposal development; let that inform the proposed scope.
- Estimate both schedule and cost conservatively by accounting for remaining unknowns and for expected cost growth during proposal development and during Phase A.
- Identify cost-driving parameters clearly and consistently (including TRL, modifications from heritage, engineering models & spares, *etc.*)
- Use NASA Standard WBS definitions and terminology.

Cost Threats Lessons Learned

Proposal teams who do the following tend to better support their proposed reserves posture

- Apply risk management process early; plan mitigations appropriate for the proposed project class.
- Encumber appropriate amounts of cost reserves against those risks that could impact schedule and/or cost.
- Determine the levels of funded schedule reserve and of unencumbered cost reserves that would be adequate and robust for the proposed project –as well as their phasing.
 - Unencumbered cost reserves higher than the minimum AO requirement, and funded schedule reserves higher than typical practices, may be necessary for some elements of some projects, such as those requiring specific technology maturation.
 - Remember to also carry unencumbered cost reserves against the encumbered cost reserves; encumbered cost reserves are part of the base PIMMC.
- Remember that appropriate cost reserves could be either the minimum required by the AO, or higher as assessed by the TMC evaluation panel based on the justification provided by the proposal.

Additional Information on Cost Estimation

- NASA WBS Handbook in the Program Library
https://soma.larc.nasa.gov/STP/DYNAMIC/pdf_files/NASA%20SP%2020210023927%20WBS_Handbook.pdf
- NASA Cost Estimating Handbook: <https://www.nasa.gov/content/cost-estimating-handbook>
- Note that several NASA cost models that may be relevant to some projects are free to proposers and do not require cost expert training (spreadsheet-based and compatible with Mac and PC). These include:
 - Project Cost Estimating Capability (PCEC)
 - NASA Instrument Cost Model (NICM)
 - Mission Operations Cost Model (MOCET)

Access can be requested at <https://software.nasa.gov/software/category/all/aw/1/cost>.

Use of these models is not a requirement nor an expectation.



References

DYNAMIC AO Reference Material

DYNAMIC Acquisition Home Page

The DYNAMIC acquisition home page is available at

<https://soma-d.larc.nasa.gov/STP/DYNAMIC/index.html>

The contents of the web site include the following:

- Community announcements and DYNAMIC AO news
- Links to the DYNAMIC AO and to SAM.gov
- DYNAMIC AO Q&As
- Evaluation Plan
- Preproposal conference materials
- Teaming interest

DYNAMIC AO Reference Material

DYNAMIC Program Library

- The Library provides additional regulations, policies, and background information. The Library is accessible at <https://soma-d.larc.nasa.gov/STP/DYNAMIC/programlibrary.html>
- It is incumbent upon the proposer to ensure that the documents used in proposal preparation are of the date and/or revision available in the Program Library.
- A detailed Change Log has been implemented, and will continually document updates to the Program Library.

Questions and Answers

- Questions sent to the PS and AM are answered on the Acquisition Homepage at <https://soma.larc.nasa.gov/STP/DYNAMIC/faq.html>
- Questions are welcome up to 14 days before proposal due date (August 8th).
- Questions are anonymized before publication on the web page.
 - The Evaluation Panels are not made aware of what proposers originated which questions.
- Publication ensures that all proposers have equal access to the same information.

TMC Evaluation

- **Common Causes of Major Weaknesses References**

- Technology Readiness Level:

- *Assessment of TRL in AO-Based Evaluations and Common Causes of Major TRL Weaknesses*
- Located in Program Libraries

- Management:

- *Common Management Major Weaknesses in Step One Proposals*
- Located at SOMA website:

<https://soma.larc.nasa.gov/tmcll/ManagementFindingsStudy-to-post-R3.pdf>

The image is a composite of three distinct astronomical scenes. On the left, a view of Earth from space shows its blue and white surface, with a complex network of glowing blue and yellow magnetic field lines extending from the poles. The background is a deep blue space filled with numerous small, distant stars. On the right side, there is a large, detailed close-up of the Sun, showing its turbulent, fiery surface in shades of orange, red, and yellow. The overall composition is set against a dark, star-filled cosmic backdrop.

Questions?

All further questions pertaining to the DYNAMIC AO
MUST be addressed by email to:

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elisabeth.l.morse@nasa.gov

(subject line to read “DYNAMIC AO”)

