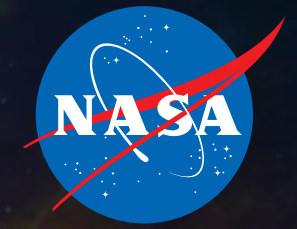
National Aeronautics and Space Administration



Dynamic Neutral Atmosphere-Ionosphere Coupling (DYNAMIC) Solicitation: Concept Study Phase

Phase A Kick-Off:
Criteria & Requirements for the Concept Study Report

Elisabeth L. Morse, Washito A. Sasamoto, and Omar Torres – Acquisition Managers

NASA Science Office for Mission Assessments (SOMA)

August 12, 2024

Outline

References Annotation

- Discussions may reference relevant solicitation documents/materials
  - AO §#.# AO Section
  - AO Req. ## AO Requirement
  - C&R §#.# Criteria and Requirements for the Phase A Concept Study Report (C&R) Section
  - Req. CS-## C&R Requirement
  - §#.# C&R Section (section within C&R Part II)
  - EP ## AO Evaluation Plan slide
  - PL *XYZ* Program Library document
  - PPC *XYZ* ## Pre-Proposal Conference presentation, slide
  - Q&A *X*-## AO Questions & Answers entry

Criteria & Requirements Document: Overview

The *Criteria & Requirements for the Phase A Concept Study Report* (C&R) document contains instructions for preparation of the Concept Study Report (CSR).

- An updated draft version of the C&R has been posted to the Program Library of the DYNAMIC Acquisition Homepage: https://soma.larc.nasa.gov/STP/DYNAMIC/index.html. After the ongoing SMD review is completed, a final version will be posted.
- Requirements are designated as CS-1 to CS-152.
- Note the following language from the document:
  - All program constraints, guidelines, definitions, and requirements specified in the AO are applicable to the CSR.
  - Only new requirements and modified requirements appear in the C&R for the Phase A Concept Study document.
  - In case of conflict between the DYNAMIC AO and the C&R document, the C&R document takes precedence.
  - Each CSR must be a self-contained document and must not refer to information contained in the Step 1 proposal.

    The only permitted exception is Appendix L.18. Science Change Matrix

Criteria & Requirements Document: Updated Criterion C Factors (1 of 4)

- All of the Technical, Management, and Cost (TMC) Feasibility factors defined in AO Section 7.2.4 apply to the evaluation of the CSR
- All of the AO factors, updated C&R factors, and new C&R factors are evaluated to ensure the CSR's technical, management, and cost feasibility are at least at a Phase A level of maturity.
- In the C&R document, changes in Evaluation Factors from the AO are noted in *blue italicized text*. Some bullets on the major changes are noted below. More detail on each is provided in the C&R document, PART I.

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

- Includes assessment of *the adequacy of backup plans*

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

- Includes more details for *ground systems, operational scenarios and timelines for each mission phase, operations team roles and responsibilities, and navigation/tracking/trajectory analysis*

Updated Criterion C Factors (2 of 4)

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

- Includes *an assessment of the adequacy of the plans for spacecraft systems engineering, qualification, verification, mission assurance, and launch operations*
- Maturity and technical readiness assessment includes that of *the operations system*
- Includes *the adequacy of the plan to mature systems within the proposed cost and schedule, the robustness of those plans, including recognition of risks and mitigation plans for retiring those risks, and the likelihood of success in developing any new technologies*

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

- Includes assessment of the *WBS; project level systems engineering*
- The named Key Management Team includes at least the PI, the PM, and the PSE
- Includes evaluation of *the approach to managing commercial suppliers that will use their own safety and mission assurance (S&MA) practices*
- Risk management aspects of AO Factor C-4 are used as basis for new Factor C-6 in Step 2

Updated Criterion C Factors (3 of 4)

- Factor C-5. Adequacy and robustness of the cost plan, including cost feasibility and cost risk
  - Includes *the methods and rationale used to develop the estimated cost*
  - Includes *the proposed cost management tools to be used on the project.*
- Factor C-6. Adequacy of the risk management plan
  - Derived from Factor C-4 of the AO
  - Also includes *[t]he approach to any proposed descoping of mission capabilities*
  - Where there are proposed cooperative arrangement or contribution, *when no mitigation to risk is possible, this should be explicitly acknowledged.*

Updated Criterion C Factors (4 of 4)

Two new factors are added in Step 2:

- *Factor C-7. Ground Systems*

  This factor includes an assessment, including heritage and planned new development, of the proposed operations facilities, hardware, and software (i.e., those for mission operations and science operations), and a telecommunications analysis, ground network capability and utilization plan, and navigation plans.

- *Factor C-8. Approach and feasibility for completing Phase B*

  This factor includes the completeness of Phase B plans and the adequacy of the Phase B approach. This assessment will include evaluation of the activities/products, the organizations responsible for those activities/products, and the schedule to accomplish the activities/products.

Criteria & Requirements Document: CSR Outline per Req. CS-5

- The format of the CSR is specified in Sections A through L
- The CSR Structure and Page Limits are specified in Table 2
  - 2 pages for Fact Sheet and 6 pages for Executive Summary
  - 34 pages for Section D, Science Investigation plus STM foldout (mark changes from Step 1)
  - Base of 110 pages for Sections E through H:
    + 3 pages for each separate, non-identical instrument
    + 2 pages for each separate, non-identical flight element (total of two above limited to 20 additional pages)
    + 4 pages if at least one multiple-build spacecraft bus or instrument is proposed
    + 10 pages for all SEOs combined, if proposed

      Reserved for SEOs and must be Section E –Science Implementation Section
    + Schedule foldouts
  - No page limits for Section I, *Cost Proposal*, and Section J, *Justification & Cost Proposal for optional Science Enhancement Options (SEOs)*
  - 5 pages for Student Collaboration (SC), if proposed
  - No page limit for Section L Appendices
- Appendices shall not be renumbered

Deferred Step 1 items Required for Step 2
from C&R Table 1

- The C&R document requirements take precedence.

	Topic	AO Reference	C&R Reference
1	Independent Verification and Validation of Software	AO §4.6.1	Req. CS-39
2	Details of coordination with Conjunction Analysis Risk Analysis	AO §4.6.4	Req. CS-120 and Appendix L.11
3	Science Enhancement Option or its cost, if proposed	AO §5.1.5	Section J
4	Discussion of maximum channel bandwidth compliance	AO §5.2.6.2	Req. CS-45 and Appendix L.19
5	Discussion of critical event coverage capabilities	AO §5.2.7	Req. CS-39 and Req. CS-45
6	Orbital debris and end of mission disposal plan	AO §5.2.8 and §J.8	Appendix L.11
7	Non-AMMOS system use description	AO §5.2.9	Appendix L.27
8	Description of the Space Systems Protection implementation	AO §5.2.10	Appendix L.20
9	Ground system data flow diagram	AO §5.2.11	Appendix L.21
10	Naming of Project Manager (PM) and Project Systems Engineer (PSE)	AO §5.3.2 and 5.3.3	Req. CS-59
11	Student Collaborations, if proposed	AO §5.5.2	Section K
12	Discussion of cost estimate error and uncertainty	AO §5.6.3	Req. CS-84
13	Schedule-based end-to-end component of the Data Management Plan	AO Appendix B, §E.4	Appendix L.6
14	Requirements for real year dollar costs	AO §5.6.2	Section H

Criteria & Requirements Document: CSR Page Count Limits Examples for Sec E-H

- Examples of page count limit calculations are notional for the sake of clarification
- Base total for §E-H is 110 + 3 + 2 = 115; maximum possible = 144 incl. 10 for SEO only

	Example 1	Example 2	Example 3	Example 4
Concept example	*1 spacecraft carrying 2 instruments, proposing 3 different SEOs*	*2 identical spacecraft each carrying the same 3 instruments, proposing no SEO*	*2 identical spacecraft busses where 1 carries 2 instruments and another carries the Auroral Imager, proposing no SEO*	*1 Smallsat with 2 instr., plus 3 Cubesats with 2 other instr. and 3 different Cubesats with 1 instr.; proposing 1 SEO*
§E-H Base	110 + schedule foldouts	110 + schedule foldouts	110 + schedule foldouts	110 + schedule foldouts
Non-identical instruments*	2 x 3* = 6* additional max	3 x 3* = 9* additional max	3 x 3* = 9* additional max	5 x 3* = 15* additional max
Non-identical flight elements*	1 x 2* = 2*	1 x 2* = 2*	2 x 2* = 4*	3 x 2* = 6* additional max
Multiple builds	0	4	4	4
SEO**	10**	0**	0**	10**
Limitations on additional*?	6* + 2* = 8* < 20*	9* + 2* = 11* < 20*	9* + 4* = 13* < 20*	15* + 6* = 21* > 20*
Total Sections E-H	110 + 8* + 0 + 10** = **128** *where 10** are for SEO* **+ schedule foldouts**	110 + 11* + 4 + 0** = **125** *where 0** are for SEO* **+ schedule foldouts**	110 + 13* + 4 + 0** = **127** *where 0** are for SEO* **+ schedule foldouts**	110 + 20* + 4 + 10** = **144** *where 10** are for SEO* **+ schedule foldouts**

*per C&R Table 2, additional pages for instruments and flight elements limited to 20
**per C&R Table 2, additional pages for SEO limited to SEO; cannot be used for another purpose

Criteria & Requirements Document: List of CSR Appendices

new in Step 2

1. Letters of Commitment and Letters of Support
2. Relevant Experience and Past Performance
3. Resumes
4. Inclusion Plan
5. Phase B Contract Implementation Data
6. Data Management Plan
7. Citizen Science Plan
8. Incentive Plan(s)
9. Technical Content of any International Agreement(s)
10. International Participation Plans (Update from Proposal)
11. Requirements Related to Orbital Debris, Collision Avoidance and End-of-Mission
12. Compliance with Procurement Regulations by NASA PI Proposals
13. Master Equipment List
14. Heritage
15. Classified Materials. [separate submission]
16. Small Business Subcontracting Plan
17. Additional Cost Data to Assist Validation (Optional)
18. Science Change Matrix
19. **Impact to the Investigation if GDC Data are not Available** — DYNAMIC-specific
20. Communications Design Data
21. Space Systems Protection
22. Cybersecurity
23. Draft Mission Definition Requirements Agreement
24. Draft MAIP and MAR Compliance Matrix
25. **Rideshare Accommodation Worksheet** — DYNAMIC-tailored
26. **Storage Plan** — DYNAMIC-specific
27. **Flexibility to Launch Configuration** — DYNAMIC-specific
28. Justification for the use of non-AMMOS MOS/GDS Tools
29. Acronyms and Abbreviations List
30. References and Management Standards List

Criteria & Requirements Document: CSR Submission per Req. CS-6, CS-7, CS-8, CS-11

- The CSR with all Appendices is due 4 p.m. ET, May 12, 2025
  - Accompanied by final version of CSR participants file
- The augmented submission is due 4 p.m. ET, May 19, 2025
  - Trajectory supplement, if applicable (Req. CS-38)
  - Schedule in MS-Project format (Req. CS-52)
  - MEL in MS-Excel format (Req. CS-129)
  - Rideshare Accommodation spreadsheet (Req. CS-146)
  - Program and Project Management Standard References, if applicable (Req. CS-151)
  - All Cost Tables in MS-Excel format (Req. CS-90, CS-91 and CS-97)
  - Excel spreadsheets or model files to accompany the additional cost data to assist in validation, if applicable (§L.17)
- All files shall be submitted via NASA Box.
- Electronic CSRs shall be unlocked, bookmarked, and searchable PDF file(s) –limited to the main body of the CSR, all tables and appendices, with no embedded audio, video or animations and no external links.
- Materials identified as subject to U.S. export laws and regulations, in accordance with AO §5.8.3, must be marked

List of Participants and Table of CS Requirements

- Requirement CS-9 The Concept Study Team shall provide a list of the individuals who have participated in the concept study (e.g., individuals who worked on the CSR, any CSR contributor, Red Team member, reviewer, etc.) and/or whom they are proposing to provide work should the mission be down-selected. Additionally, the Study Team shall provide a list of all organizations named in the CSR, or providing developmental or research services, including the lead organization, subcontractors, vendors and contributing organizations who have an interest in the mission. The Concept Study Team shall provide the draft list of the participants as a Microsoft Excel spreadsheet document to the point-of-contact [Dr. Jared Leisner] (POC, see AO Section 6.1.5) three months prior [Feb 12, 2025] to the due date of the CSR [May 12, 2025], using the Microsoft Excel spreadsheet template in the Program Library. This list is to be updated and a final revision shall be included in a separate electronic file at the time of CSR submission.
- Requirement CS-10 The Concept Study Team shall create a separate document that contains a table with all of the requirements (Requirement CS-1 through Requirement CS-152) and the page, section, or table number that is the main place in the CSR where the requirement is addressed. Concept Study Teams shall provide this table as a PDF document to the point-of-contact for the AO by email no later than seven calendar days after the CSRs are due. [Augmented submission: May 19, 2025]

Rideshare Requirements

per Req. CS-39, CS-146, SIS 6.3.5.1 and SIS Appendix A

As described in AO §5.9.2., the DYNAMIC flight system design must be compatible with rideshare launch as specified in the *DYNAMIC System Interface Specification* (SIS) document in the Program Library, consistent with a GFE access to space utilizing Rideshare on Government Primary launches.

- The SIS document in the Program Library is in the process of being updated to include clarification for the Phase A Concept Study.
  - Loads will be updated to reflect maturation of potential launch vehicles.
- The Program Library will include a Step-2 version of the *Rideshare Accommodation Spreadsheet* template, consistent with Phase A level of detail.

Trajectory Supplement

Requirement CS-38 Trajectory for Electric Propulsion: For any mission using Electric Propulsion to achieve orbit, the following information shall be provided in a file or files along with the augmented submission as part of a trajectory supplement. Any graphical references, tables, figures, etc. shall be presented in a minimum of 150 dots per inch (dpi).

- Checkout Duration: The minimum duration allocated after launch before the primary propulsion system will be commanded to provide required delta-v.
- Initial Mass Assumptions: Provide the initial mass used for generation of the trajectories including propellant loading assumptions.
- Event Basics: Provide the date/time of each trajectory event with a brief event description (e.g., Launch, Gravity Assist, Fly-by, Rendezvous, Mid-Course Burn) and the appropriate data for the event (e.g., flyby altitude, flyby angle, flyby/intercept velocity, delta-v magnitude).
- EP Throttling Model: Provide the throttling model used to generate EP engine performance at any point during the trajectory and a brief explanation of the approach.
- Assumed Engine Duty Cycle: Provide the overall Duty Cycle for the EP engines and if applicable provide the duty cycle over each trajectory segment.
- Number of Engines: Provide the maximum number of engines on the spacecraft that could be operating simultaneously. In addition, provide the number of engines operating throughout each phase of the trajectory.
- Any other trajectory specific information not called out above that would be relevant to reviewers attempting to validate the EP aspects of the trajectory and orbit, should also be included.

Orbital Debris, Collision Avoidance, End-of-Mission

Orbital Debris (§L.11)

Requirement CS-123 This appendix shall discuss briefly how the mission meets the NPR 8715.6 and NASA-STD-8719.14 orbit debris requirements applicable to its proposed orbit. For LEO missions, this appendix shall briefly discuss the lifetime of the mission and whether it meets the 25-year post mission requirement [...]

Requirement CS-124 **This appendix shall provide a brief description, including any cost deltas, of the impact on the investigation if the 25-year post-mission orbital lifetime requirement is changed to 5 years.** This description shall assume that the requirement change is implemented at PDR. The evaluators may submit comments to the Selection Official on appendix material that addresses this requirement.

Requirement CS-125 If the plan is to dispose of the satellite at the end of mission, this appendix shall provide the parameters of the disposal orbit, the delta-v allocation for disposal, and any other relevant assumptions.

Conjunction Assessment Risk Analysis (CARA)

- NASA Interim Directive (NID) 7120.132 has been superseded by NASA Procedural Requirement (NPR) 8079.1 on June 27, 2023. For this CSR evaluation, NID 7120.132 is still in effect. The official guidance in NPR 8079.1 will be imposed for down-selected missions.
- The Program Library includes Office of the Chief Engineer (OCE)'s document OCE-51, *NASA Spacecraft Conjunction Assessment and Collision Avoidance Best Practices Handbook*

Spectrum Considerations: AO Extract

AO Section 5.2.6.2:

> [...] NASA intends to transition all space missions to the use of K/Ka-band for science data return. In order to better manage the Agency's transition to K/Ka-band service, proposed investigations are highly encouraged to baseline the use of K/Ka-band for science data return, unless it is inappropriate. **The recommendation for K/Ka-band is based on efficient use of limited radio frequency (RF) spectrum** and does not preclude use of X-band or S-band for telemetry, tracking, and commanding (TT&C).
>
> Radio frequency spectrum for telecommunications is allocated by service (*e.g.*, Earth Exploration-Satellite, Space Research, and Space Research in Deep Space) and may be further constrained by maximum channel bandwidth limits as shown in the *Available Spectrum and Channel Limits By Allocated Service* document in the Program Library.

Spectrum Considerations: C&R Extract

- Requirement CS-42 includes:

(c) Telecommunications, Tracking, and Navigation including:

(i) downlink information and data volume;

(ii) uplink information;

(iii) for all transmit and receive modes: mode timeline, data rate(s), durations, **and planning for compliance with spectrum limitations**, including compliance with maximum channel bandwidth;

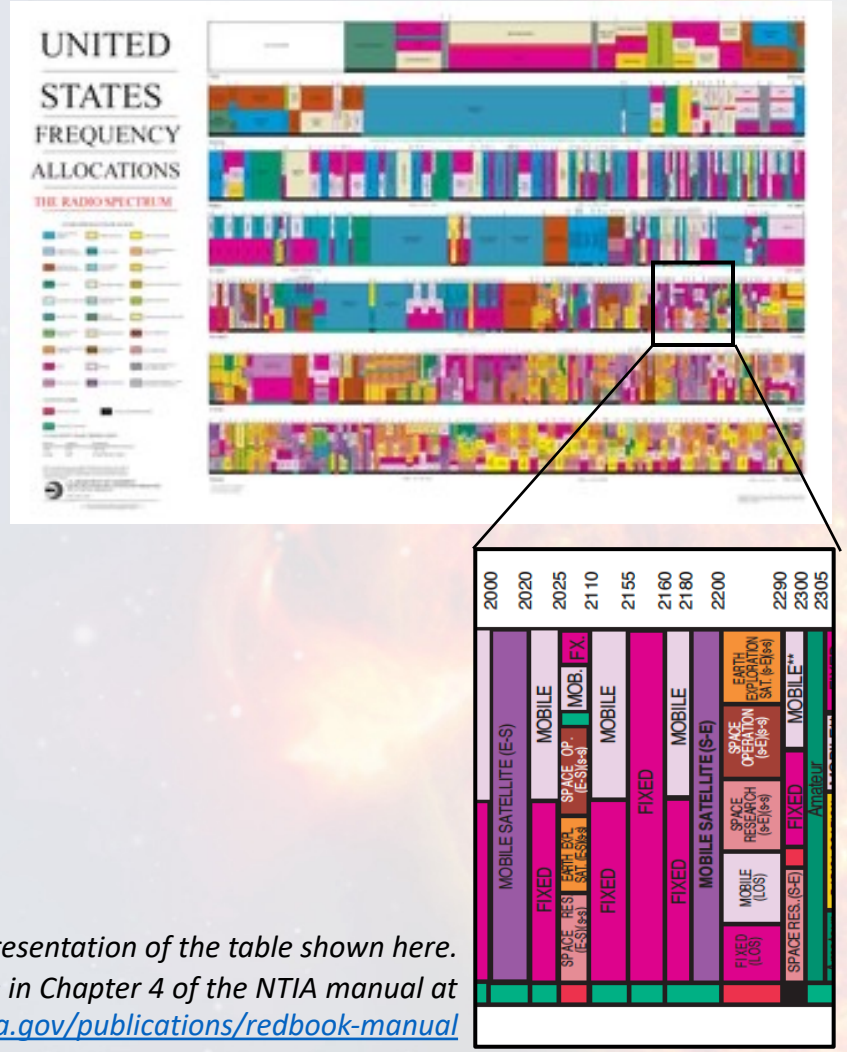
(iv) ground network utilization plan including ground stations, downlink parameters (frequencies, periods, capacities, margins, etc.), and retransmission capability; and

(v) approach for acquiring and returning data, including clear identification of procurement and costing for supplemental resources (e.g., mobile ground stations) if such are needed

Spectrum Considerations: Definitions

- **Allocation (of a frequency band):** Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned.
- **Primary services** grant specific services priority in using a particular swathe of allocated spectrum. In cases where there are multiple primary services within a band, they have equal rights. A station has the right to be protected from any others that start operation at a later date.
- **Secondary services** involve services that must protect all primary allocations in a particular band. Services operating in secondary allocations must not cause harmful interference to, and must accept interference from, primary users. All secondary service stations have equal rights among themselves in the same band.
- **Authorization** – via frequency assignments – is the process by which users are licensed to access the spectrum resource.

https://www.ntia.doc.gov/files/ntia/publications/2003-allochrt.pdf



Graphical representation of the table shown here.
See the official table in Chapter 4 of the NTIA manual at
https://www.ntia.gov/publications/redbook-manual

Spectrum Considerations: Frequency Selection Process

- Frequencies are selected based on a compatibility analysis between the new and incumbent systems at the frequencies and geographical regions of interest.
- New systems must not cause degraded performance to existing systems, and if necessary must accept reduced performance at the accepted frequencies.
- ITU establishes a threshold protection criteria for incumbent systems in the form of acceptable interference:

Interference Threshold Criteria*	
Uplink/Downlink	Io/No not to exceed -6 dB more than 0.1 % of the time

- As part of the frequency assignment process, Spectrum analysts run compatibility analysis for all frequencies within the allocation and at various duty cycles to find a channel/duty cycle combination where the mission meets the ITU threshold.
  - This analysis assumes that transmitter is ON only when in-view of the Ground Stations (GSs). The results of this analysis (and by extension, the authorization) is only valid in the regions surrounding the GSs.
  - This analysis is ran against all existing systems of relevance to each of the GS.
  - This analysis can result in limitations imposed on the mission over one or several of the requested GSs.

*Criteria vary by band. Consult your spectrum manager or the ITU Radio Regulations for a complete set of criteria.

Spectrum Considerations: Frequency Selection Process Results

- The total time to obtain a spectrum authorization is highly variable and can take 12-24 months.
- Compatibility analyses, and by extension RF authorizations, are only valid in the geographical areas surrounding the approved ground stations (*any* changes to the RF system or the mission ConOps invalidates the license, and the authorization process is restarted).
- International rules on accessing spectrum may result in a reduced duty cycle on RF systems that decreases the mission data downlink time.
- Examples of limitations imposed, as a result of the spectrum compatibility process, on some current NASA science missions using S-band (similar situations can happen at X-band):
  - Reduce downlink duty cycle over a given ground station (examples have included duty cycles reduced **to** 15%, some to 55%, after frequencies were assigned)
  - Account for link margin degradation equivalent, due to potential interference, over a given ground station (examples have included additional link margin degradation >4.5dB)
  - Potential for some ground stations not being approved due to saturation of the market in certain geographical areas.
  - Inability to secure access to GS when the request was made after frequency selection
  - Inability to approve requests for additional ground stations on time for launch, if the ground stations were not part of the initial spectrum authorization.

Spectrum Considerations: Power Spectrum Density

- Also note NTIA limitations on power spectrum density: see table 8.2.36 on NTIA manual
  - Limits power spectrum density (PSD) at the surface of the Earth produced by emissions from a spacecraft, , for all conditions and for all methods of modulation, in terms of *dB(W/m²) for Angle of Arrival (δ) Above the Horizontal Plane*

Table: 8.2.36 (Section 1)

Frequency Band	Service	Limit in dB(W/m²) for Angle of Arrival (δ) Above the Horizontal Plane			Reference Bandwidth
		0°- 5°	5°- 70°	70°- 90°	
1670 - 1690 MHz[3)] 1690 - 1700 MHz (Nos. 5.381 and 5.382) 1700 - 1710 MHz 1761-1842 MHz[5)] (See G42) 2025-2110 MHz[5),6)] 2200-2300 MHz	Space Research (S-E)(S-S) Space Operation (S-E)(S-S) Earth Exploration-Satellite (S-E)(S-S)	-154 [2)]	-154 + 0.5 (δ - 5)[2)]	-144 [2)]	4 kHz
8 025-8500 MHz	Earth Exploration-Satellite (S-E) Space Research (S-E)	-150	-150 + 0.5 (δ -5)	-140	4 kHz

Space research S-band extract

Space research X-band extract

https://www.ntia.gov/sites/default/files/2023-11/8_2021_edition_rev_2023.pdf

Conclusion: Spectrum Considerations

1. Spectral band saturation varies by frequency and geographical location
2. Downlink time reduction can occur due to the imposition of duty cycles as a result of the RF compatibility analysis
3. Additional link margin degradation can result from RF interference at the GS of interest
4. Spectrum approval can take 18 (+/- 6) months after every update to the RF system or ConOps (e.g. adding ground stations)
5. There are further regulatory limitations specific to the spectral band of interest (see the footnotes of each allocation in the NTIA manual)
6. Consult the Program Office Spectrum Manager for further advice (for STP: nasa-dl-gsfc-spectrum-management@mail.nasa.gov)

Cost Related Items

L.17. Additional Cost Data to Assist Validation (Optional)

In addition to the specific cost table data requested in the Cost Proposal (Section I), investigation teams may also provide any additional costing information/data that they feel will assist NASA to validate the project's proposed costs. Vendor quotes, cost estimates, rationale for design heritage cost savings, are all examples of data that can be included here. Input and output files for any publicly available cost model may be included with the augmented submission, if accompanied by discussion in this appendix.

The information provided may also include cost by NASA fiscal year to the lowest level of detail the project is working with, in Microsoft Excel format.

TMC Cost Process

The backup section explains the TMC Cost Analysis process (already discussed in DYNAMIC Pre-Proposal Conference)

Site Visits

- Site visits with oral briefings will be used to clarify implementation details and commitments.
- Site visits are anticipated ~3 months after the CSR due date at location sites to be coordinated between each PI/Concept Study team and NASA HQ/SOMA.
- The site visit durations will be up to 7 hours plus up to 1 hour for an optional tour / demonstration.
- All site visit presentations / briefings shall be in a plenary session with all Evaluation Team members attending - no splinter sessions.
- Written significant weaknesses, questions, and/or requests for information will be provided to the PI/Proposal Team 7 days before the site visit. All teams will have the same lead time.
- Some questions will require an early response, 2 days before the site visit.
- Any additional information provided to NASA by the Concept Study team at the site visit, in response to the NASA-identified weaknesses and questions, or in response to NASA requests for additional information, will be treated as updates and clarifications to the CSR.

Phase B Plan

- Immediately following the continuation decision (i.e., down-selection), the successful team will be requested to submit a formal cost proposal based upon the Federal Acquisition Regulation (FAR) Part 15. The instruction and format for submission of this formal cost proposal are found in FAR Part 15.403-5 and Table 15.2. The team will be required to provide cost and pricing data for Phase B that are necessary and required to implement the contract for Phase B. Complete cost and pricing data will be required for each organization participating in Phase B. These data should allocate project costs per the cost categories defined in Table 15-2 of the FAR.
- Once entering Phase B, the DYNAMIC project will be subject to the same requirements as all other NASA missions. Note that the CSR only satisfies some of the KDP-B deliverable requirements, and that the balance will have to be developed early in Phase B (consistent with Section 2.2.7.1 in NPR 7120.5: “In a two-step AO process, projects are down-selected following evaluation of concept study reports and the down-selection serves as KDP B. Following this selection, the process becomes conventional, with the exception that products normally required at KDP B that require Mission Directorate input or approval will be finished as early in Phase B as feasible.”).

Additional Documents in the Program Library

https://soma.larc.nasa.gov/STP/DYNAMIC/programlibrary.html

- Updated *System Interface Specification* (SIS)
- Step 2 version of the *Rideshare Accommodation Spreadsheet*
- Updated FY 23 NASA Inflation Tables for FY24
- CSR Conflicted Party List Template
- Microsoft Excel versions of the Step 2 *Cost Template Tables* in the C&R document
- Level 1/Level 2 Requirements Presentation from PI Forum
- Program Level Requirements Appendix (PLRA) examples (Psyche, TESS)
- Mission Definition Requirements Agreement (MDRA) example (ICON)
- Space Systems Protection documents FIPS PUB 140-3, NASA-STD-1006A, and FAQ
- Samples of International Agreement examples (Juno with Belgium, MSL with France)

Points of Contact

- Launch Services Program (LSP): Rex Engelhardt, Mission Manager/Rideshare Lead, rex.a.engelhardt@nasa.gov
- Space Communications and Navigation: Jeff Hayes, NASA HQ SCaN Program Office, jeffrey.hayes-1@nasa.gov
- Spectrum Office: nasa-dl-gsfc-spectrum-management@mail.nasa.gov
- Project Protection Plan and Cybersecurity: Jerry Esper, SMD Program Executive for Systems Security, jerry.s.esper@nasa.gov

Questions?

Please review the Criteria & Requirements document as soon as possible, so questions can be address in a timely manner.

Initial deadline for questions on the C&R: September 4, 2024

All further questions pertaining to the DYNAMIC AO and C&R

MUST be addressed by email to:

Dr. Jared Leisner
DYNAMIC Program Scientist
Science Mission Directorate
NASA Headquarters
Washington, DC 20546
jared.s.leisner@nasa.gov

Elisabeth L. Morse
DYNAMIC Acquisition Manager
Science Office for Mission Assessments

elisabeth.l.morse@nasa.gov

(subject line to read “DYNAMIC AO")

Backup: 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/.
- Questions are welcome up to 14 days before CSR due date (*i.e.*, by April 28, 2025).
- 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

- **<u>Common Causes of Major Weaknesses References</u>**
- 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

Back-Up: 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

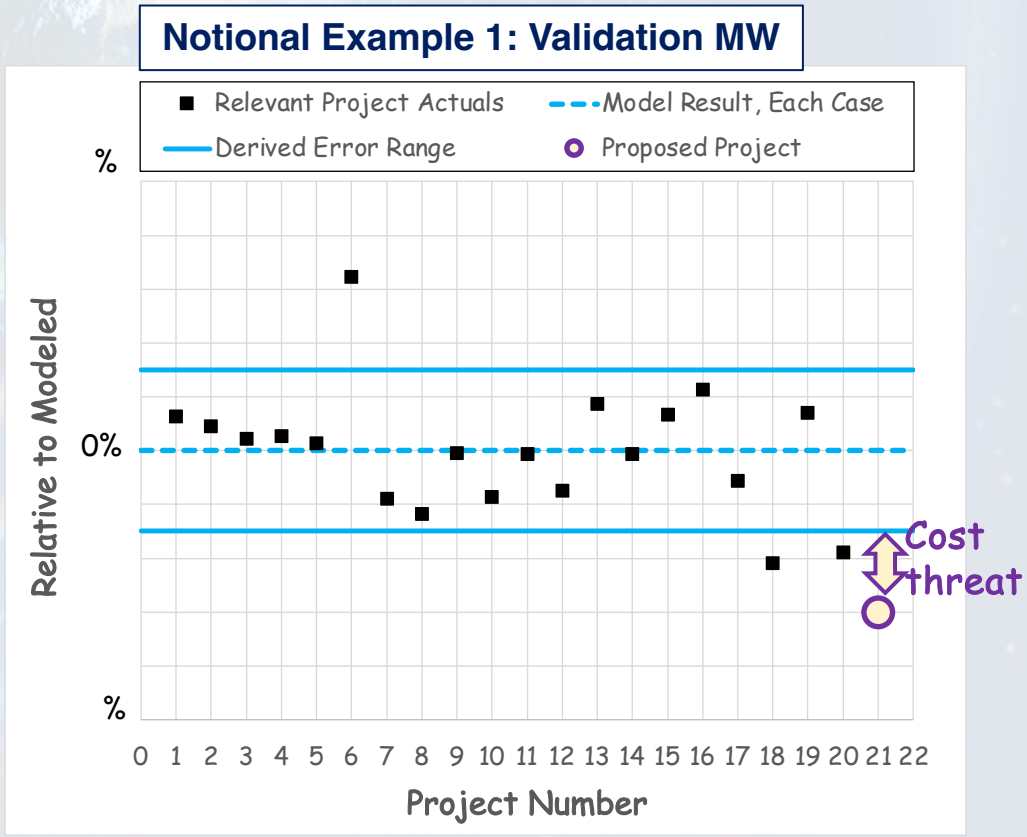
The proposed costs for WBS X.XX cannot be validated, as the TMC Base Independent Cost Estimate exceeds the proposed cost by more than the error range.

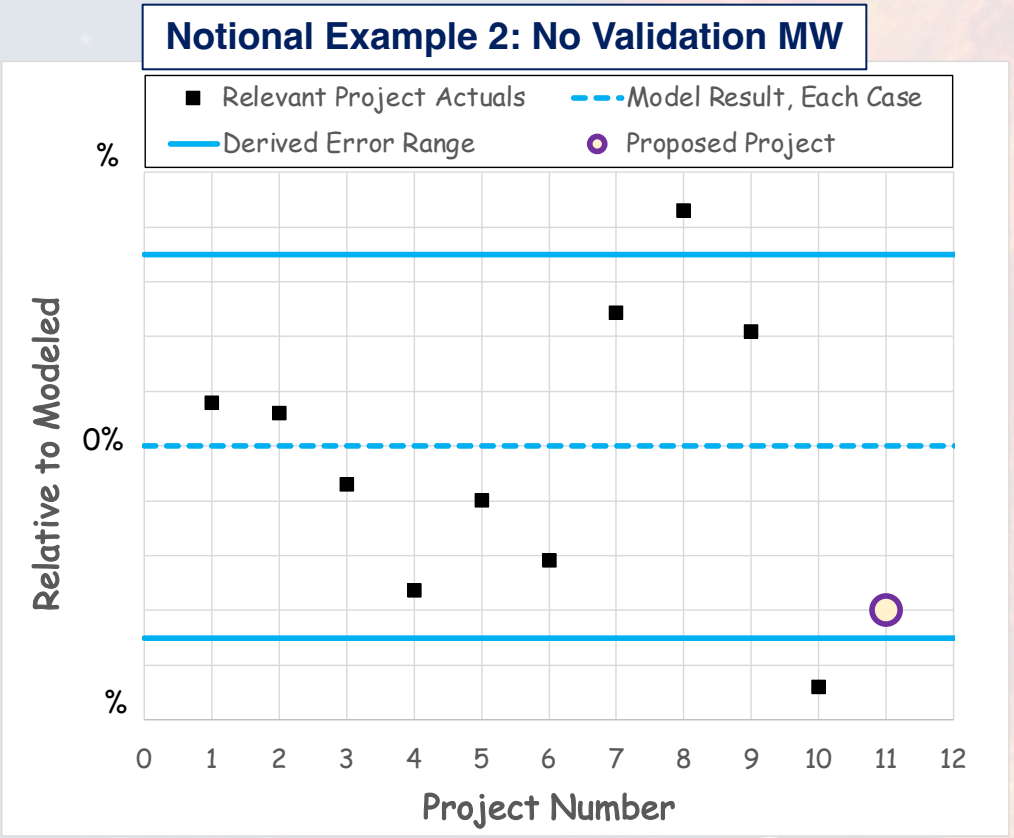
The TMC Base ICE:
- combines the results of the models used (no reserves)
- is performed with the best performing models selected after testing several models against past actuals relevant to this acquisition
- follows the same process, for all proposals in this acquisition
- uses inputs that are based 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.

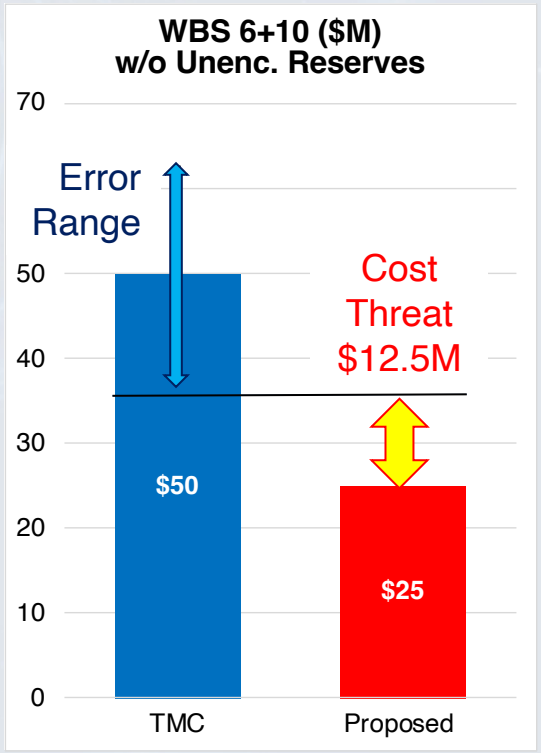




Decoding Cost Validation MW: Example

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

	Likelihood of Occurrence	Weakness	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					
			Very Minimal 0.5% < CI ≤ 2.5% ($xM < CI ≤ $xM) *1% < CI ≤ 2.5%* *($xM < CI ≤ $xM)*	**Minimal** 2.5% < CI ≤ 5% ($xM < CI ≤ $xM) *2.5% < CI ≤ 5%* *($xM < CI ≤ $xM)*	**Limited** 5% < CI ≤ 10% ($xM < CI ≤ $xM) *5% < CI ≤ 10%* *($xM < CI ≤ $xM)*	**Moderate** 10% < CI ≤ 15% ($xM < CI ≤ $xM) *10% < CI ≤ 15%* *($xM < CI ≤ $xM)*	**Significant** 15% < CI ≤ 20% ($xM < CI ≤ $xM) *15% < CI ≤ 20%* *($xM < CI ≤ $xM)*	**Very Significant** CI > 20% (CI > $xM) *CI > 20%* *(CI > $xM)*
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

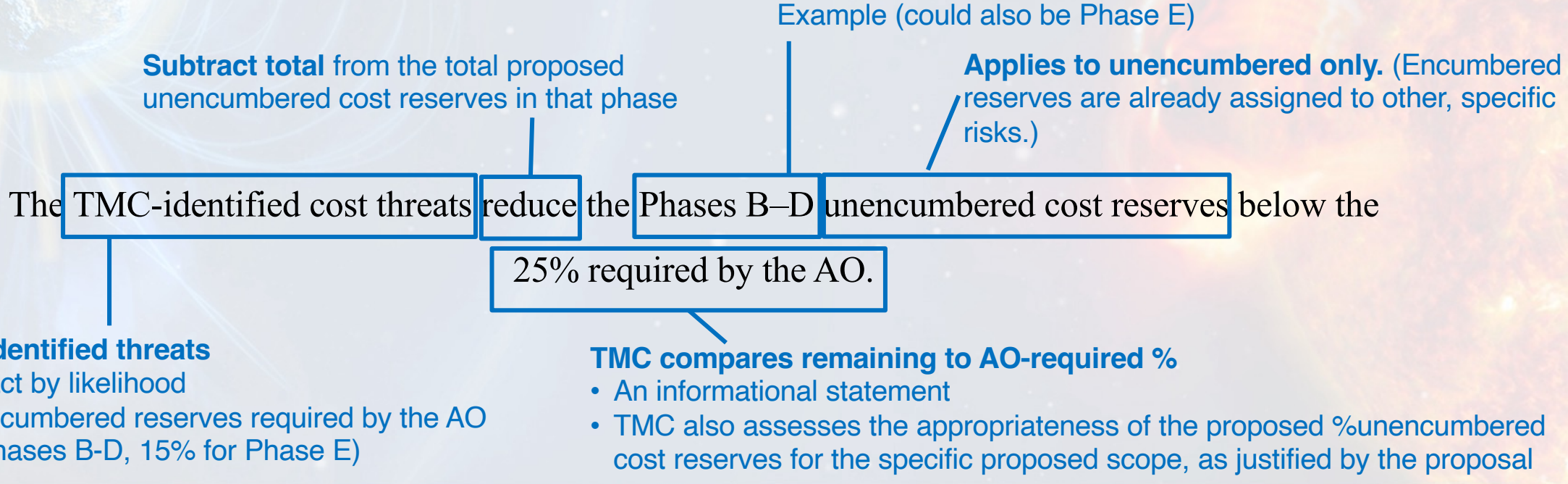
- The TMC considers that the Technology Readiness Level (TRL) is overstated and that it is likely that a TRL development plan will be required before KDP-C. The notional example PIMMC for Phases B-D is $100M.
- The TMC estimates that the cost for an adequate TRL development plan would be in the range 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.



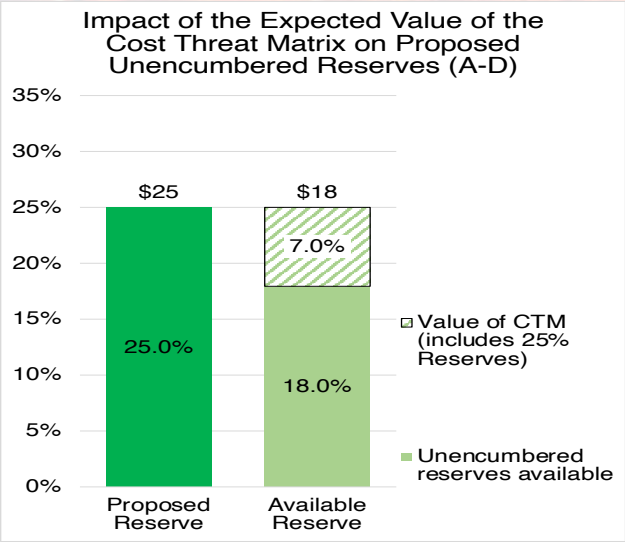
Decoding Summary Statement: Example

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%.

		Cost Impact (CI) % of Baseline Mission Cost to complete Phases B-D not including unencumbered cost reserves or contributions					
Likelihood of Occurrence	**Weakness**	**Very Minimal** $1.0M<CI≤2.5% ($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)
AlmostCertain (L>80%)							
VeryLikely (60%<L≤80%)							
Likely (40%<L≤60%)	**TRL Maturation**		**$1.9**				
Possible (20%<L≤40%)	**Cost Validation**		*$3.75M x 50% = $1.9M*		**$3.7**		
Unlikely (L≤20%)							

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
Proposed unenc. reserves minus expected cost threats %	18.0%



Clarification of Cost PMWs

The Clarification (Step 1) or SQRL and Site Visit (Step 2) process offers a chance for updating cost information

Information from proposers provided in Clarifications (Step 1) or in SQRL responses and during the Site Visit (Step 2) 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 initial proposal (Step 1) or CSR (Step 2) submission.

- 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 (Step 1) or CSR (Step 2), “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 (Step 1) and Req. CS-78, CS-79 (Step 2) describe requirement for the Basis of Estimate (BOE):
  - Traceable to the WBS of Table B3 (Step 1) or B3a and B3b (Step 2),
  - 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,
  - If applicable, document the multiple-build costing methodology,
  - 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.
- 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 (or Significant Minor in Step 2), 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.