

Enterprise Mission Integration for Artemis Lunar Missions

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Abstract—Mission integration is an iterative process by which a specific mission is formulated, refined, planned, and executed within the established vehicle(s), architecture, and ground systems design. Mission integration includes the people, vehicle(s) and ground hardware/software, products, processes, analyses, schedules, facilities, Certification of Flight Readiness, etc. The Artemis Mission Integration Task Team (MITT) developed a series of products and processes to support the complex mission integration across various Programs within the Artemis Mission Campaign (Orion, Space Launch Systems, Exploration Ground Systems, Gateway, Human Landing System, and Extravehicular Activity and Human Surface Mobility). The Moon to Mars (M2M) Program is referred to as ‘the enterprise’ as it includes both the M2M organization and the Programs supporting the Artemis Mission Campaign. Artemis Mission Integration has five phases: mission capability, mission definition, mission preparation, mission execution, and post-mission assessment. This paper focuses on one of the enterprise-level mission checkpoints as a kick-off to the Mission Preparation phase, the Mission Integration Review (MIR), which occurs 18-24 months prior to launch. The MIR helps to confirm the defined mission technical baseline is within the existing analyzed design envelope. Details are provided on the identification of dependencies, issues, or gaps for mission-specific objectives and requirements, as well as the definition of the analysis, training, mission execution products, facilities, and detailed supporting operations requirements. The MIR was held for both Artemis I and II and this paper aims to share with the aerospace community its value as we prepare for upcoming Artemis Missions.

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1. INTRODUCTION

NASA is aggressively moving forward with the next generation human spaceflight systems to meet the nation’s human space exploration goals. The Moon to Mars (M2M) Program, within the Exploration Systems Development Mission Directorate (ESDMD), seeks to integrate and lead the development of these exploration capabilities. These efforts contribute to NASA’s efforts to accomplish the goals expressed in the 2022 NASA Strategic Plan [1]:

- Strategic Goal 2: Extend Human Presence to the Moon and on towards Mars for Sustainable Long-term Exploration, Development, and Utilization
- Strategic Objective 2.1: Explore the Surface of the Moon and Deep Space

Using a phased approach, NASA is expanding human exploration efforts, starting with exploration, science, and technology research aboard the International Space Station (ISS), extending beyond Low-Earth Orbit (LEO) to the Moon to Mars exploration phases.

M2M is responsible for the portfolio of capabilities under development encompassing the Exploration Ground Systems (EGS) Program, Orion Program, Space Launch Systems (SLS) Program, Gateway Program, Human Landing System (HLS) Program, Extravehicular Activity (EVA) and Human Surface Mobility (HSM) Program (EHP), and future M2M programs/projects, and for integration of the Artemis missions [2].

While the M2M products apply specifically to NASA government organizations, there is no intent to constrain or direct contractor involvement in support of M2M development activities or in the cross-program integration process. Any contractor support or involvement in the activities and processes described in M2M products is governed by individual Program policies, contracts, and/or requirements. Under the guidance of the ESDMD, M2M leads integration in the areas of joint contributions to the objectives of the Artemis Mission Campaign for the manifest, mission definition, budget, requirements, and risk. M2M

delegates contract management to the Programs. The Programs provide direction to providers that is consistent with M2M direction [3].

Moon to Mars Exploration Operations, Mission Integration

The M2M Program within ESDMD has five offices, one of them being Exploration Operations, which houses the Artemis Mission Integration Task Team (MITT). The MITT leads the development and integration of the mission technical baseline for an Artemis Mission [3,4]. This is achieved by collaborating with stakeholders to establish the mission technical baseline documentation for key mission parameters, ground rules and constraints (GR&C), as well as establishing top-level mission objectives, integrating end-to-end Artemis Mission objectives, and providing recommendations on priorities for mission objectives for the end-to-end Artemis Mission.

The MITT is responsible for:

- Developing the M2M Mission Integration Implementation Plan (MIIP) working closely with the various Artemis Program representatives.
- Chairing the MIIP Working Group which is responsible for collaborating and coordinating the Artemis mission integration and implementation processes and products across the enterprise.
- Developing and managing the Artemis Mission Campaign and Increment-level integrated traffic and event plans.
- Establishing and configuration managing the authoritative mission definition for the end-to-end Artemis Mission, including the mission prioritized objectives, mission requirements and cross-program operational GR&Cs.
- Ensuring mission-specific requirements, objectives, priorities, payloads, and utilization is flowed down into operations plans and products.
- Designating Mission Leads for specific Artemis Missions who are responsible for:
 - Partnering with the assigned Mission Manager
 - Leading development and integration of mission technical baseline information captured in the mission-specific MITT products
 - Chairing the Artemis Mission Integration Forum (AMIF) responsible for coordination of the mission technical baseline information
- Leading the implementation of the mission integration milestones.
- Leading Mission Management Team (MMT) Support Console (MSC) functions.

Mission Integration Definition

At the enterprise level, Mission Integration is defined as: “Defining, preparing, conducting and assessing a mission within a defined architecture and system capabilities, in order to achieve M2M strategic goals” [5].

Mission Integration Implementation Plan

The MIIP defines the M2M mission integration processes for managing mission requirements, decisions, risks, and operations for missions within an Artemis Mission Campaign. Mission integration utilizes the established vehicle(s), architecture, and ground systems design to implement and execute a defined mission.

The MIIP establishes cross-program mission integration roles and responsibilities from mission development through post-mission assessment; as well as the mission-unique parallel and serial integration activities, including mission integration milestones and integrated mission-specific analyses and products. In addition, the MIIP defines content, scope and accountability for developing, supporting and managing the technical baseline for the strategic logistics allocations and utilization plan to support campaign development, as well as the tactical requirements for each Artemis Mission. Mission planning and integration activities defined in the MIIP culminate in mission-specific certification, mission execution, and post-mission assessment activities [5,6].

To ensure safe and successful Artemis missions, a structured approach to the integration across the activities within an Artemis Mission Campaign for this multi-program and multi-center effort is needed. Hence, the M2M mission integration approach is divided into five phases.

2. MISSION INTEGRATION PHASES

Mission integration processes start with defining an Artemis Mission and the mission complement which make up an Artemis Mission Campaign and culminates in executing and evaluating the defined Artemis Mission. Mission integration includes the people, vehicle(s) and ground hardware/software, products, processes, analyses, schedules, facilities, Certification of Flight Readiness (CoFR), etc. The M2M approach breaks the mission integration process into five phases: Mission Capability, Mission Definition, Mission Preparation, Mission Execution, and Post-Mission Assessment. The work performed in a phase is often iterative and each subsequent phase builds upon the work done in a previous phase, achieving a more mature level of fidelity and detail through the process. For each mission integration phase, the processes, key products and roles and responsibilities are described in subsequent sections. See Figure 1 for the mission integration phases.

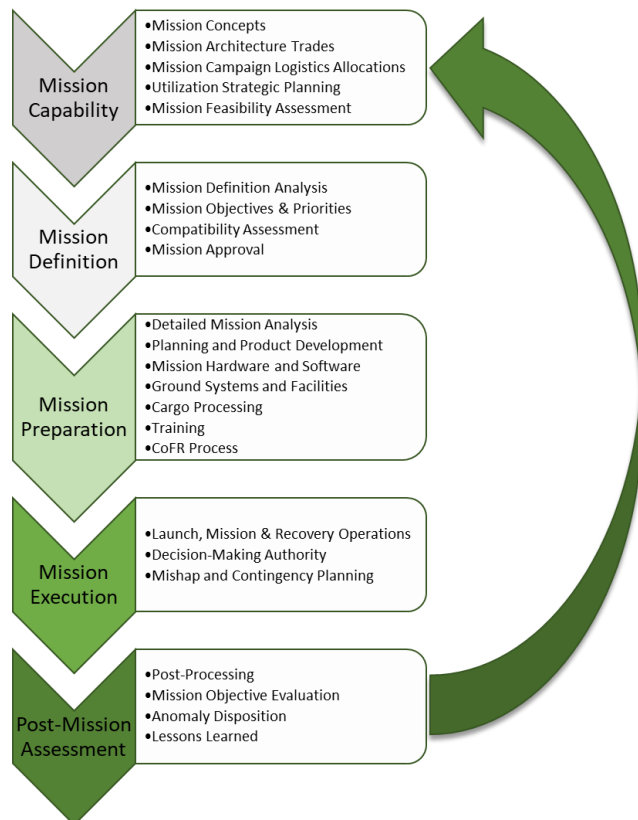


Figure 1. Mission Integration Phases Overview

Mission Capability Phase

The Mission Capability phase starts with the development of an Artemis Mission concept within the Artemis architecture, including M2M Program mission concepts; these elements form an Artemis Mission Campaign and where applicable, mission services are procured to support the mission concepts. Strategic logistics allocation and utilization planning begins in tandem with the mission concepts developed in this phase. The MIIP focuses on evaluation and analysis of the Artemis architectural elements selected to be available for a mission in order to narrow down to a single mission concept and begin the mission integration processes defined further in the MIIP. As concepts solidify, a Mission Definition Baseline (MDB) Dashboard is developed and provides the mission-specific technical baseline key parameters which drive mission analyses used to refine the mission concept and inform contracting mechanisms for Programmatic needs.

Mission Definition Phase

The Mission Definition phase starts with a general Artemis Mission concept and a proposed set of mission objectives and allocations for constrained resources across Programs and NASA Mission Directorates that support the Artemis Mission. This transition from the Mission Capability phase is not marked by a specific milestone or deliverable, but rather

when M2M analyses have sufficiently determined a general mission concept is feasible and the existing systems capabilities can support a successful mission. Development and testing of mission services, such as EVA suits or commercially provided vehicles are monitored by responsible Programs and M2M throughout the Mission Definition and Mission Preparation phases in support of their eventual use in the Artemis Mission Campaign.

Mission objectives and priorities are refined, integrated, prioritized via a Mission Priorities Summit (MPS), and approved by M2M via baselining a mission-specific MDB document. M2M and the Programs perform compatibility assessments to the detail necessary to verify that the proposed mission concepts are within their respective integrated system design capabilities and provide approval on proposed missions within the Artemis Mission Campaign. The Mission Integration Review (MIR) is the culmination of the Mission Definition phase, where the Artemis Mission objectives, mission integration schedule, and risk to safety and mission success are reviewed and, upon approval by M2M, direction is given to proceed with development of the mission-specific products necessary for mission execution.

Mission Preparation Phase

The Mission Preparation phase begins with the agreed-to Artemis Mission coming out of the MIR, and includes the planning, analysis, and training needed to prepare for real-time Artemis Mission execution. The mission preparation phase also includes the vehicle, cargo, and payload hardware and software assembly, integration and testing needed to prepare for the specific Artemis Mission. To prepare for an Artemis Mission, the dependencies (e.g., software releases, trade study results, integrated test results) identified in the mission integration schedule are prioritized and managed to support procedure development, integrated analyses, training, and resource allocation. Mission Preparation is also an iterative phase where the mission execution products are developed and revised as the analyses are refined; facilities and ground system changes are implemented; and training is accomplished. This phase ends when the people, products, facilities, and vehicles are matured, and CoFR is completed.

Mission Execution Phase

The Mission Execution phase for the Artemis Mission begins at the SLS/Orion launch countdown call-to-stations and ends with the Orion Crew Module arrival at KSC. It includes the SLS/Orion launch countdown operations, mission operations and recovery operations. The Artemis Mission follows the crew on their journey and encompasses the SLS/Orion launch, Earth-lunar transit, connectivity with a supporting mission element (as applicable), lunar orbit, transit to/from and including lunar surface (as applicable), lunar-Earth transit, through Earth landing. Mission execution includes the performance of mission objectives such as utilization, system

evaluation and technology demonstration. The products and processes needed to execute the Artemis Mission were developed in the Mission Preparation phase. During the Mission Execution phase, coordination and smooth handoff between multiple centers, control teams, engineering/support teams, management, and external organizations is critical to mission success.

Post-Mission Assessment Phase

The Post-Mission Assessment phase occurs after the Mission Execution phase is complete. Evaluation of the Artemis Mission objectives and the vehicle/ system performance is accomplished by analyzing the recorded, downlinked, measured, and reconstructed flight data. Any anomalous events or conditions which occur during mission execution are investigated and assessed for corrective action and future impacts. Lessons learned are collected to identify process improvements for incorporation into subsequent missions.

3. KEY MISSION INTEGRATION MILESTONES

Mission integration by nature is complex and iterative, and the work performed for development and execution of an Artemis Mission Campaign occurs over the course of several years. At any given time, there will be multiple Artemis Missions at various stages of mission integration occurring simultaneously. Mission integration checkpoints, led by M2M, occur at specified intervals with the respective Programs and stakeholders to ensure the Artemis Mission Campaign is cohesive and on track to meet campaign goals. A notional representation of mission integration for a single Artemis Mission over time, combined with key milestones is represented in Figure 2.

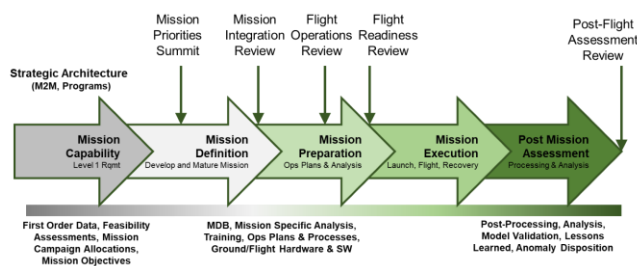


Figure 2. Mission Integration Overview with Key Milestones

M2M Mission Integration milestones are conducted to ensure the enterprise is ready for the next phase of the mission integration process. These review milestones may be conducted standalone or as part of existing program, cross-program, or board structures as deemed appropriate. Each organization is responsible for preparing, contributing, and presenting, at each of the Mission Integration milestones: Mission Priorities Summit (MPS), Mission Integration Review (MIR), Flight Operations Review (FOR), Flight Readiness Review (FRR), and Post-Flight Assessment Review (PFAR).

The MPS occurs in the Mission Definition phase at approximately Artemis Mission Launch minus (L-) 33 months to support the MDB document baseline efforts in advance of the MIR and the Mission Preparation phase.

The MIR occurs at approximately Artemis Mission L-2 years to allow adequate time for mission preparation and integration among multiple Programs. Subsequent sections of the paper focus on this milestone.

The FOR occurs no later than Artemis Mission L-7 months to allow adequate time for joint simulations and training before launch. The FOR is focused on ensuring all necessary integrated mission-specific requirements and objectives have been implemented by the Flight Operations team into the mission operations execution products.

The NASA Agency FRR occurs approximately 7 days prior to the launch of the Artemis Mission and certifies that the capabilities needed for a specific Artemis Mission and select supporting missions have been prepared and verified against the baselined mission requirements. FRR provides the final authority to proceed with the mission execution activities.

The PFAR occurs approximately 3 months after an Artemis Mission is completed.

4. MISSION INTEGRATION REVIEW OBJECTIVES

The following is a list of MIR objectives which must be met, or have an acceptable closure plan defined, in order to conclude the enterprise is ready to begin development of mission-specific operations products and analyses.

1. The mission-specific objectives and requirements are achievable within the integrated flight and ground systems detailed design capabilities and hardware configuration.
2. Mission-specific requirements are sufficiently mature to proceed with mission preparation.
3. Mission product development, analysis, and training plans meet the needs of the mission and are achievable.
4. Open work is clearly identified with acceptable plans and schedule for their disposition. This includes To Be Determined (TBD) or To Be Resolved (TBR) with associated closure plan, actions, problems, unexplained anomalies, and previous in-flight anomalies
5. Operations hazard controls have been identified and are at the appropriate maturity level for mission product development.
6. The integrated schedule supports the targeted launch date and properly captures operational dependencies.
7. Risks to mission preparation and execution activities have been assessed with plans and resources in place to manage them effectively.

5. MIR PRODUCT AND ACTIVITIES SUMMARY

The following is a list of products and activities that are used to support the MIR. These products and activities form the basis for the summaries and briefings provided by the review participants.

1. The integrated flight and ground system design and secondary payload design are baselined or development plans are in place to support mission-specific analyses and mission product development.
2. Mission product development, analysis, training, and operational plans are sufficiently mature to proceed with baselining.
3. Schedules needed to support the mission are available, including:
 - a. Hardware/software delivery, integration, processing, and testing
 - b. Facilities, including Ground Support Equipment and Special Test Equipment
 - c. Training
 - d. Mission product development and analyses
4. Flight/Ground/Payloads Hazard and Integrated Hazard Reports requiring operational hazard controls have been identified.
5. The mission product development, analysis, training, and operational plans are consistent with the processes defined in the Safety and Mission Assurance Plan and the MIIP.
6. Other technical work products (as applicable) for hardware, software, and human system elements have been made available to the cognizant participants prior to the review via the nominal change of request process:
 - a. A baselined integrated detailed design that meets the M2M integrated requirements and key technical performance measures
 - b. Technical data package (e.g., integrated schematics, interface control documents, and integrated system specifications)
 - c. Defined operational limits and constraints, GR&Cs
 - d. Updated technical performance measures
 - e. Command and telemetry list
 - f. Enterprise preliminary operations safety analyses
 - g. Open problems with closure plan, open unexplained anomalies during verification and validation as applicable to other Programs, and previous In-Flight Anomalies, as applicable.
7. Risks have been identified, credibly assessed, and characterized, and mitigation efforts have been defined. Similarly, waivers, deviations, and non-conformances that are approved or planned for the mission have been documented.
8. Mission requirements and objectives, including the MDB, are baselined or development plans are in place to support mission-specific analysis.

6. MIR ROLES AND RESPONSIBILITIES

Given that the MIR is a key M2M Mission Integration milestone, it is chaired by the M2M Deputy Associate Administrator (DAA), led by the Artemis Mission Manager, and implemented by the Exploration Operations MITT. These three players are part of the MIR Board Membership, as well as Program Managers, Flight Operations Director, Technical Authorities, and M2M Division Directors. Other key participants include the Launch and Recovery Director, Flight Crew Representative, Artemis Mission Lead, Training Lead, etc.

The MIR Board Members are responsible for making integrated risk-based decisions to either confirm readiness to proceed or to halt product development to address mitigation options, if needed. The Mission Manager develops a Mission Liens and Threats List, containing the list of known enterprise and cross-program liens and threats to the defined mission. The Mission Manager also defines a mission launch date used for MIR assessments and ensuring consistent comparison of dependencies, analysis, schedules, etc., with the caveat that the launch date is only for assessment purposes and not necessarily an official launch date.

Participating Programs and organizations for the Artemis Mission-specific MIR need to coordinate and integrate the development of their topics with the stakeholders, ensuring that completed packages meets the topic category expectations. This includes identifying issues and open work that negatively impact the topic or readiness to proceed to the Mission Preparation Phase, and identifying decisions needed from the MIR Board.

Technical Authorities are responsible for independently assessing the MIR to confirm readiness to proceed to the Mission Preparation phase.

7. MISSION INTEGRATION REVIEW ROADMAP

Five steps have been identified to be able to conduct a MIR: preparation, readiness assessment, dry run, execution, and post-MIR. These are detailed next along with some lessons learned from Artemis I and II, which are implemented for the MIR continuous improvement in upcoming Artemis Missions.

Preparation

The MITT coordinates the review preparation, including agenda, review schedule, invitation letter, and meeting logistics. Part of this is the clear communication of expectations, responsibilities, and logistics, which can be done via a kick-off meeting, a formal memo or invitation letter, and supported by follow-up conversations with the participating teams for any necessary clarification. A MIR portal should be made available to capture the schedule, logistics information, presentation templates, etc. For Artemis I and II MIRs, all the above forms of communication were used. For Artemis I, an extensive effort was expended

to explain the purpose and needs of a MIR to the participants, as a MIR has not been done before. Normalizing terminology was an important aspect of the preparation process and is expected to continue to be a lesson learned as the complexity of the missions grow moving forward. Moving to Artemis II, less education on MIR purpose and process was required and the teams continue to gain efficiency in their processes going forward.

Readiness Assessment

A readiness assessment is conducted to identify issues with continuing to execute the MIR and to identify additional special topics. Special topics should identify required content and duration to enable the presenter to build the presentation. For Artemis I and II, the Mission Manager in coordination with the Artemis Mission Lead, Programs, and FOD, conducted an internal readiness assessment approximately six weeks prior to the MIR to ensure preparations were adequate and on schedule to support the MIR. At the MIR readiness assessment, the teams review the product development status, open work, actions, MIR agenda, planned special topics, and schedule to determine if the MIR objectives can be met or if additional actions are needed.

Dry Run

The dry run is a one-day event focused on an overview of the agenda presentation content (top-level story board) by the presenters. The overview should highlight known issues, actions, and decisions requiring management attention/resolution. For Artemis I and II, the Mission Manager in coordination with the Programs and FOD, conducted a dry run approximately three weeks prior to MIR, which provided enough time for presenters to make any additional updates to their content if needed.

Execution

During the MIR event, an overview of the mission is provided along with the briefing topics, which provide evidence that the MIR objectives have been met. The MIR agenda is structured around the mission integration phases. It opens with an overview of the mission technical baseline. The first focus is the integrated mission compatibility assessments to identify any open work, risks, issues, or gaps presented by the cross-program teams. The next section is on the Program and organization mission preparation plans, schedules, and any hardware/software risks that may impact the preparation for the mission. This is followed by an integrated chronological mission execution overview. The Programs, operations agents, and participating organizations present their plans for training and support of each mission phase (e.g., launch, on-orbit, lunar surface, recovery). By focusing the presentations in chronological order, and not by Program delegated responsibilities, it allows the Board Members and Technical Authorities to see the integration and flow of approaches through the expected mission.

The last section is reserved for any special topics identified at the Readiness Assessment or Dry Run. Once all the presentations are complete, the Mission Manager and Technical Authorities act as independent reviewers to assess the MIR and the data presented to ensure the objectives have been met. Each of these Board Members provides an assessment of the MIR objectives (meets/does not meet), summary of liens and threats to the mission, and a recommendation of any additional actions to be assigned. The M2M DAA, as the MIR Chair, reviews the actions and polls all the Board Members for 'go' to proceed to the Mission Preparation phase.

Post-MIR

Following the MIR, it is expected that the actions are completed. Actions are worked and tracked via the AMIF. The actionees are responsible for ensuring completion of action items and notifying the Board of action completion. The product owners assess potential impacts from actions and provide inputs to actionees as requested. The product owners also incorporate updates on next revision of products per the action closure plan if required.

In order to improve and streamline the process for future MIRs, lessons learned are identified during the review to enhance future reviews, in addition to modifying the process to include topics that provide management awareness.

8. CONCLUSION

As with any new process or activity, conducting the MIR received some push back and questioning from different participants; however, its value was recognized after the Review was completed in both instances for Artemis I and II. The feedback received from the participating Programs emphasized that the MIR was very beneficial to take the time to focus on one mission. Previous traditional lifecycle reviews focused on each Program individually presenting their piece of the information. MIR was unique in its integrated focus of the mission execution plans and content. Projects which involve multiple parties benefit from a focus on the integrated story, ensuring the sum of the piece-parts meet the intent of the whole. This will be key for upcoming Artemis Missions as the number of additional programs increase, hence the mission complexity also increases.

Having a review like MIR well in advance of the CoFR events at the end of the mission integration cycle is paramount in ensuring mission success. It ensures all teams understand and agree to the mission goals and parameters, with enough time to redirect resources, update plans and minimize schedule and cost implications to the mission. The MIR provides a checkpoint for the parent organization (M2M in this case) to assess progress on the ability to meet integrated schedules, discuss and ensure plans for preparations are in place and sufficient to meet mission timing and goals, and identify risk areas to cost, schedule, and mission goals based on this interim status.

The MITT is driven by the ‘integration’ term. The processes and products put in place were in response to some gaps within existing NASA Procedural Requirements (NPRs) such as NPR 7120 NASA Space Flight Program and Project Management and NPR 7123 NASA Systems Engineering Processes and Requirements, which are used to guide the management of programs and projects at NASA [7,8]. While the established life cycle reviews in those documents provide specific milestones to ensure we are on the right path to completing a particular project, they may not account for continuous missions and lack guidance on mission-specific content. Artemis, like other human spaceflight programs, does not consist of ‘one and done’ missions. NASA flies many missions, often different from each other, to build complex architectures and infrastructures that will be used for different purposes. Therefore, to ensure what we build achieves the specific target, and that the numerous teams are ready for every mission, the mission integration phases and milestones discussed in this paper were established. This is done by merging various individual technical pieces together into a single, cohesive mission. This is what drove the need for having MIR, a checkpoint to ensure everyone is working toward the same goal. The MIR ensures all plans are in place to develop all operation products and training to execute the specific mission.

While MIR is used for human spaceflight, it can be applicable to different programs and industries which have ongoing missions that need to be executed using the same infrastructure in an evolving manner and for different purposes. The MITT, now under M2M Exploration Operations, will continue leading mission integration efforts for upcoming Artemis missions, reflecting the team’s adaptability and flexibility by incorporating any improvements and adjusting the processes based on the needs of the specific mission.

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BIOGRAPHY



Mary Anne Plaza received her B.S. in Aeronautical and Astronautical Engineering at the University of Illinois, Urbana-Champaign. She currently leads Artemis Mission Integration for the Moon to Mars Program, Exploration Operations Office at NASA Johnson Space Center. During her 37 years at NASA, she has worked in numerous roles supporting the Space Shuttle Program and assembly of the International Space Station, including 11 years in Flight Integration and Operations and over 3 years as a Space Shuttle Flight Manager. Prior to that, the previous 12 years were spent in Mission Operations supporting flight planning for Space Shuttle missions.



Alexis McCauley-Slack has a B.S. in aerospace engineering from Texas A&M. She is currently an Artemis Mission Integrator in the Moon to Mars Program Exploration Operations Office supporting the Mission Integration Task Team. During her 30 years in the aerospace sector, she has held numerous roles, including Reliability and Logistics Engineer & Analysis Lead for the International Space Station, Risk Analyst, Requirements Management, Systems Engineering Lead for multiple projects. She is currently serving as a Senior Systems Engineer in the Exploration Operations Office on the Mission Integration Task Team.



Jaime Marshik has a B.S. in Aerospace Engineering and Mechanics and a M.S. in Astronautical Engineering. She has worked for NASA supporting Human Spaceflight for more than 20 years via leadership roles in the areas of operations, mission, and Program integration for the Space Shuttle, International Space Station and Moon

to Mars Programs. She was most recently an Increment Manager for the International Space Station Program, providing leadership, integration and programmatic technical direction to multi-disciplinary teams in developing and implementing mission requirements. She is currently serving as an Artemis Mission Definition and Integration Lead for the Moon to Mars Program, Exploration Operations Office.



Jackelynne Silva-Martinez has a B.S. in mechanical and aerospace engineering, M.S. in aerospace engineering, M.S. in aeronautical science, and PhD in leadership. During her 15 years in the aerospace sector, she has held different roles, including Human Systems Engineering and Integration Manager for the Lunar

Gateway Program, Mission Operations Planning Engineer for the International Space Station, Robotics Test Operator for the Mars Science Laboratory, Mechanical Systems & Project Engineer for the GPS III Program, and Assembly Test & Launch Operations Systems Engineer for commercial and government satellite programs. She is currently serving as Artemis Mission Integrator in the Moon to Mars Exploration Operations Office supporting the Mission Integration Task Team at NASA Johnson Space Center.