

Miniature X-ray Device (MXD)

BACKGROUND

As NASA prepares to send the next man and the first woman back to the Moon for sustained habitation on the lunar surface, the agency needs the capability to implement medical resources to identify and treat medical needs. Imaging technologies are one such capability needed to diagnose and treat a wide range of medical conditions. Where possible, NASA seeks to leverage existing commercially available technologies and platforms to reduce costs and accelerate schedule. The modification of commercial off the shelf technology is frequently needed to enable function of these devices in spaceflight including the harsh launch conditions and unique physical changes that occur in microgravity.

With the advent of commercial crew programs, there is expected to be a variety of low earth orbit (LEO) options to increase technology readiness levels (TRL) of miniaturized imaging devices beyond the International Space Station. The increase in TRL is a necessary process to test and validate devices in spaceflight with the goal of long duration exploration missions for sustained operations on the lunar surface. Performing technology demonstrations in LEO and beyond LEO is part of this roadmap to ensure adequate resources are available for manned long duration missions.

BASE ORDER DESCRIPTION

NASA is focused on identifying and addressing gaps in medical capabilities and medical system design to ensure and optimize crew health and performance during exploration missions. The development of advanced, miniaturized imaging technology including x-ray modalities has been identified as part of a larger effort to develop key technologies that will be needed for long duration exploration missions that require crew to venture into deep space where the real-time communications, frequent resupply, and rapid abort scenarios we rely on today will not be possible.

The technical goals and objectives of the miniature x-ray device (MXD) project are the engineering concept development and design, with a future base order capturing the hardware development (build, testing, integration, verification, and ISS operations) to validate a demonstration system in microgravity targeting a tech demo aboard the ISS by September 2028. This base order captures efforts and documentation deliverables required to get to a preliminary design review (PDR), which shall be led by the contractor with appropriate NASA stakeholder participation on the review board.

As part of this work, the contractor shall capture potential dependencies and technical integration opportunities for engaging with planned health data management systems aboard the spacecraft. As NASA looks ahead to long duration manned spaceflight missions, the integration of medical data is necessary to capture relevant data from physicals, blood draws, pharmaceutical usage, medical diagnostics including imaging results, and others.

SCOPE OF WORK

NASA does not yet have the capability to implement medical resources that enhance operational innovation for medical needs and imaging technologies which are a critical component for diagnosis and treatment for a broad range of medical conditions. NASA and its contractors and grantees, grantees from other federal agencies, and companies in the private sector perform similar work in this area. As a result, NASA intentionally follows technology developments across the broad medical device industry to understand state of the art technologies and look for opportunities to leverage existing technology capabilities to avoid expensive and timely development processes applicable to exploration mission scenarios.

Per Section 4.5 Preliminary Design and Technology Completion in the Statement of Work, the objectives for this base order focus on the initial concept development and design of a miniature x-ray device, including:

- Initial work will focus on pre-phase A development with the goal of understanding the commercial trade space to incorporate into a draft technology development plan and concept of operations.
- Understand integration points with other planned medical devices and vehicle or habitat systems with which the MXD may interface.
- Perform a market survey of existing commercial technologies that are reasonable candidates for miniaturization and modification for spaceflight.
- Perform a technology downselect with stakeholder participation as determined by the NASA project manager and funding program.
- Draft a requirements document with input from a cognizant NASA project scientist.
- Baseline documentation in accordance with NPR 7120.5 to support a preliminary design review, which evaluates the completeness of the planning, technical, cost, and schedule baselines developed during project formulation.

GOVERNMENT PROPERTY

As this base order focuses on the initial concept development and design, government furnished facilities are not applicable.

DELIVERABLES AND REVIEWS

The NASA and contractor project managers, budget analysts, and other cognizant personnel shall meet monthly to discuss budget and milestone variances. There shall also be a monthly risk review with the NASA and contractor project managers, risk managers and other cognizant personnel.

Deliverables:

- Verification and Validation Plan baseline
- Project-Level, System, and Subsystem Engineering Requirements document baseline

- Operations Concept Documentation baseline
- Integration Plan baseline
- Design Documentation preliminary
- Systems Safety Analyses preliminary
- Phase 0/1 Safety Data Package preliminary
- Engineering Analyses preliminary
- Engineering Test Plan preliminary
- Project Risk Review baseline
- Project Schedule baseline
- Interface Control document preliminary
- Software Engineering Management Plan baseline

Review Milestones:

Milestone	Date
System Requirements Review (SRR)	5/31/24
Preliminary Design Review (PDR)	3/28/25

Associated documentation and artifacts shall be developed and available for the review board members at least 2 weeks prior to the scheduled life-cycle review. These reviews provide the basis for the decision authority to approve or disapprove the transition of the project at a key decision point to the next life-cycle phase. The SRR and PDR shall be led by the contractor with appropriate NASA stakeholder participation on the review board. Required artifacts and documents including baselined cost, schedule, and basis of estimate as well as relevant engineering, security, and safety documents are described in NPR 7120.5.