



## NASA'S Independent Verification & Validation (IV&V) Program

# IV&V CAPABILITIES & SERVICES

NASA's IV&V Program was established in 1993 as a direct result of recommendations made by the National Research Council (NRC) and the Report of the Presidential Commission on the Space Shuttle Challenger accident. Since its inception, the IV&V Program has been contributing to the safety and success of NASA's highest-profile missions by assuring the software on those missions performs correctly.

IV&V provides our mission partners with innovative solutions and capabilities that strive to help solve difficult and real problems encountered during typical project lifecycles. The program exists as a resource to help mitigate software, system, and security risks on NASA missions. Below are a few examples and highlights of the capabilities IV&V diligently delivers for NASA mission success.

## Independent Verification & Validation (IV&V)

The IV&V Office (IVVO) is responsible for providing a systems engineering function that is focused on partnering with missions to improve reliability and reduce the risk of safety and mission-critical software.

*This includes but is not limited to:*

- Applying rigorous and repeatable engineering methodologies for evaluating the correctness and quality of the software product throughout the software life cycle.
- Collaborating with projects and developers to resolve IV&V identified issues and risks.
- Providing qualitative assessments and information regarding system and software risk to project and Agency stakeholders throughout the life cycle.
- Leveraging advanced analysis tools, including a suite of static code analyzers and dynamic analysis capabilities enabled through IV&V's JSTAR lab.

NPR 7150.2 requirements result in IV&V being applied to NASA's highest profile missions which:

- Are human-rated
- Cost several hundred million dollars
- Have high priority and complexity

*\*Projects outside of these requirements can also contact the IV&V Program for potential support.*

## Jon McBride Software Testing & Research (JSTAR)



Digital Twin Factory that enables convenient flight software testing.

*Diverse Set of Use Cases:*

- IV&V Risk Reduction Testing
- Cyber Security Assessments
- Personnel Training
- Mission Operations and Day-in-the-Life Testing
- V&V and Flight Software Test Dry-Runs

*Proven approach leveraging cutting-edge in-house software framework:*

- Artemis including SLS, EGS, Orion, Gateway, HLS
- Suite of science missions (JWST, GPM, Roman, Psyche)

# Mission Protection Services (MPS)



IV&V Mission Protection Services include software security risk assessment, mission and system cybersecurity assessment and threat research, and verification and validation of space and ground software security control implementations. Through collaboration with agency leadership and mission directorate stakeholders, a complimentary capability is leveraged to uncover design and operational security concerns through engagement in system/software engineering

forums. MPS provides continued thought-provoking leadership with its analysis outcomes contributing to the maturation of systems security engineering as a discipline.

## Analysis and

## Assessment of Mission

In its analysis and assessment, MPS focuses on the mission's overall security posture by building a security strategy and identification of hazards while in development.

## Assessment Tests Can Include:

- Evaluation of vulnerability and risk management
- Evaluation of electronic and physical controls
- Analysis to determine the ground truth of implemented systems
- Technical analysis of traditional and embedded systems
- Simulation and testing of detection and response systems and staff
- Simulation and testing of detection and response by systems and personnel



The outcome of this coordination is safety and security through resiliency and survivability of NASA missions.

# Software Safety & Mission Assurance (SMA)

The IV&V Program provides tailored SMA support services to Centers, programs, and projects such as NASA's Commercial Crew Program (CCP) on request. The Program leverages subject matter expertise and other resources and capabilities developed and used for IV&V.

One such example is Code Quality Risk Assessment (CQRA) which is a methodology for assessing the risk of software "structural code" by applying a list of analyst questions based on industry best practices, coding standards, metrics, and the use of coding analysis tools. Approximately 350 code-specific attributes are examined across six (6) primary aspects comprised of 29 sub-focus areas to quantify and generate a software code quality risk score. CQRA provides a "heatmap" identifying systemic risks, concerns, or areas that need an increased level of rigor/second look. We have applied the CQRA capability to the software of the Roman Space Telescope (RST), Europa Clipper (EC), and Regenerative Fuel Cell (RFC) projects that produced risk based value-added results.

## IV&V Program SMA services include:

- Software Safety Hazards Analysis
- Software Quality Code Analysis
- Software Reliability and Fault Management Analysis
- Software Security Assurance
- Software Verification and Validation Testing Support
- Risk Identification and Mitigation
- SA Policy and Requirements Development Support
- SA Document Development Support
- Alternate Standards Assessments
- Assessment or Surveillance of IV&V Plans and Execution
- Cloud Security Assessments
- System Assessment and Authorization (A&A) Services

For more information about how NASA's IV&V Program can support you:

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