

 Independent Verification & Validation Program	IV&V Project Execution Plan (IPEP) Template	T2103 Version: E Effective Date: July 7, 2015
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AUTHORITY		DATE
Jeffrey Northey (original signature on file)	IMS Manager	07/07/2015
Wes Deadrick (original signature on file)	Process Owner	07/07/2015

REFERENCES	
Document ID/Link	Document Title
IVV QM	NASA IV&V Quality Manual
IVV 09-1	Independent Verification and Validation Technical Framework
IVV 09-4	Project Management
NASA-STD-8719.13C	NASA Software Safety Standard
NPR 8715.3C	NASA General Safety Program Requirements
S3105	Guidelines for Writing IV&V TIMs
S3106	PBRA and RBA Process

If any process in this document conflicts with any document in the NASA Online Directives Information System (NODIS), this document shall be superseded by the NODIS document. Any external reference shall be monitored by the Process Owner for current versioning.



**Independent
Verification &
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**T2103
Version: E
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VERSION HISTORY

Version	Description of Change	Rationale for Change	Author	Effective Date
Basic	Initial Release		Leigh Gatto	12/18/2008
A	Updated to reflect new organization and updates to IVV 09-4		Jerry Sims	08/12/2010
B	Update to refine content based on IPEP reviews		Jarrold Petersavage	02/18/2011
C	Modified Table 4-1 to remove dates. Modified Section 4.1.1 to reference new Appendix G.6, <i>IV&V Deliverables</i> . Removed Appendix G.6, <i>Planned Travel</i> . Removed Appendix G.7, <i>IV&V Resources</i> .	CAR: 2012-C-357. Deliverable dates moved from Section 4.11 to new Appendix G.6 since the Appendix may be updated without a signature cycle. Travel and other resources information is captured elsewhere.	Frank Huy Steve Raqué	09/21/2012

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VERSION HISTORY

Version	Description of Change	Rationale for Change	Author	Effective Date
D	Major updates throughout the entire document; some of the changes are: Replaced App B to use Focus vs. coverage and add 3 questions. Section 2 (major update) - combined Verification and Validation. Removed observations. Updated Table 4-2 Issue severity for currency. Added simulation. Removed outdated roles; added new roles. Also addressed several other comments – link here .	CAR: 2013-C-378 (aka Work ID: 4425383). Add compliance with IVV 09-1, Technical Framework; The reasons for ceasing the use of Observations are several, but most importantly they are: a. Very low usage rate; b. Inconsistent understanding of their purpose among IV&Ver's and mission projects; c. Potential value was a relatively narrow niche; and d. Changing paradigms for how we communicate potential issues to the projects. Simulation is a valuable addition to IV&V work.	Noble N. Nkwocha	05/15/2013

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VERSION HISTORY

Version	Description of Change	Rationale for Change	Author	Effective Date
E	<ol style="list-style-type: none"> 1. Revised section 1 to improve organization and reduce redundancy 2. Revised Fig. 3-1 to show PM as part of IV&V Project Team, added Security personnel, and added informal communication paths 3. Changed version explanation on the concurrence sheet to allow editorial changes without needing new signatures 4. Removed constraint on research use of export-controlled data 5. Clarified researcher NDA restriction 6. Changed "Analysis Reports" in Table 4-3 caption to "Presentations" 7. Added a Version History log 8. Revised table 2-1 to add Security artifacts 9. Revised Appendices A and B 	<ol style="list-style-type: none"> 1. Clarification 2. Clarification and adding Security 3. Allow simple clarifications and corrections to body without requiring new signatures 4. Restriction on use of export-controlled data is not covered by NDA 5. Clarification 6. To match context 7. To effectively communicate changes made 8. Expand/clarify IV&V security work 9. Clarify intent and update content 	Eric Sylvania, Michael Facemire	07/07/2015

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IV&V Project Execution Plan (IPEP) Structure

The purpose of the IPEP is two-fold. First, it is to communicate IV&V interactions, interfaces, roles and responsibilities, technical products, and reporting methods with the Project. Second, the IPEP serves as the operational document for the IV&V efforts. The IPEP is prepared and maintained by the IV&V Project Manager (PM). The IV&V PM coordinates the creation and maintenance of this document with affected individuals and organizations (within the NASA IV&V Program as well as with the Project).

The IPEP is divided into two major parts: the document body and the appendices. The document body describes the overall IV&V project and defines the basic agreements for the partnership between the IV&V Team and the Project. Once coordinated and approved, the basic agreements in the document body are not expected to change. The second part of the document, the appendices, focuses on the fiscal year activities for the IV&V efforts. The appendices contain data that are more dynamic in nature and are expected to change over the course of the Project. The appendices include the results of, or a reference to, the IV&V Heritage Review, IV&V Portfolio Based Risk Assessment (PBRA) data and subsequent Risk Based Assessments (RBA), and detailed information for each planned execution year, including items such as IV&V goals and objectives, schedule, and risks.

The IPEP may be tailored as necessary by the IV&V PM with IV&V Office Management approval.

Purpose of the IPEP Template

The IPEP Template is designed to provide the following:

1. A standard outline and format for IPEPs such that reviewers, approvers, and users of the document know where to find information
2. Standard text that is used in all or most IPEPs
3. Differentiation of standardized text and formatting from tailored text and formatting. This speeds up the NASA IV&V Program review and approval process because only differences from standard text need to be scrutinized.
4. Guidance and best practices that provide those who generate or update IPEPs with tailoring guidance and section content guidance

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IPEP Template Conventions

Different styles of text are used in this template:

1. <Text included in angled brackets>

This text represents Project-specific information to be provided and/or adjusted for; examples are <IV&V Point of Contact> for a particular role on the Project.

2. *{Red italic text in braces}*

This text is guiding or explanatory in nature. It is intended to be a heads-up and provide guidance regarding section content, content format, tailoring, possible sources and locations of information, and suggestions for filling in each section. This text should be removed before the IPEP is submitted for review/approval.

3. Normal Text

Text that appears normal (i.e., not highlighted or italicized) is intended to be common among all Projects. This is standard text that should be copied verbatim into the IPEP, unless Project-specific information should be inserted. If you think that the text is not accurate for your Project, you may propose a change and provide rationale to those who review and approve the document.

Depending on how the template format and content are adjusted to meet Project needs, the IPEP author may need to adjust the following:

- Numbering of the tables in the IPEP
- Additional acronyms in Appendix D
- The table of contents

The author shall incorporate version numbering to all versions of the IPEP for their Project. All draft versions of the IPEP shall be marked as “DRAFT” in the footer. The initial version of the IPEP shall have a version number of 1.0; the version number shall be updated by one (e.g., Version 2.0) based upon subsequent updates to the IPEP on a FY basis. Any revisions made to this IPEP during the year (e.g., during mid-year

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rebaseline efforts) shall result in an update to the number to the right of the decimal (e.g., Version 1.1).

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Template begins on the following page.}

National Aeronautics and Space Administration



Independent Verification and Validation (IV&V)

<Project Name>

IV&V Project Execution Plan (IPEP)

FY <Fiscal Year> v<Version X.X>

Updated Date: <Date>

NASA Independent Verification and Validation Facility

100 University Drive, Fairmont WV 26554

DOCUMENT COORDINATION and APPROVALS

{From an external perspective, this section captures the various signatures of all individuals who are committed to provide support/service/artifacts across the interface between IV&V and the Project. Tailor/update the listing of external signatures as applicable. For instance, if SMA or SQA personnel are expected to provide something, please include them on the signature list. The same would go for other entities that might be sought for contribution}

This is Version 1.0 of the <Project name> IPEP. Changes to the agreements in the body of this document (Sections 1-4) will trigger an increase in the base version number (i.e., Version 2.0) and subsequent review, approval, and concurrence by all entities listed below. This IPEP will be revisited and updated as necessary on a semi-annual basis. At a minimum, a new version of this IPEP will be published each fiscal year and the base version number will be increased by one (e.g., Version 2.0). Editorial revisions to the body of the IPEP and any revisions to the appendices will result in an update to the decimal part of the version number (e.g., Version 1.1). Draft versions of the IPEP will be marked as “DRAFT.”

PREPARED BY:

<IV&V PM Name>, NASA IV&V Project Manager

DATE: __/__/__

APPROVED BY:

<IV&V Office Lead Name>, NASA IV&V Office Lead

DATE: __/__/__

CONCURRED BY*:

<Project Name> Project IV&V <Point of Contact>

DATE: __/__/__

<Project Name> Project Manager

DATE: __/__/__

* Indicates concurrence with Sections 1-4 of the IPEP.

VERSION HISTORY			
Version	Description of Change	Rationale for Change	Modified By

Table of Contents

If any process in this document conflicts with any document in the NASA Online Directives Information System (NODIS), this document shall be superseded by the NODIS document. Any reference document external to NODIS shall be monitored by the Process Owner for current versioning.

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1 Introduction

1.1 Document Purpose

This IPEP has two primary purposes. First, it describes the overall <Project Name> IV&V project and defines the basic agreements for the partnership between the <Project Name> IV&V Team (hereinafter referred to as the IV&V Team) and the <Project Name> Project (hereinafter referred to as the Project). These agreements include roles and responsibilities, communications paths, IV&V products, IV&V reporting methods, and artifacts anticipated to be shared between IV&V and the Project. Second, the IPEP serves as the operational plan for the IV&V efforts.

In signing this document, Project personnel understand their concurrence signature reflects the agreements identified within the body of the document, excluding the appendices. Signatures of NASA IV&V personnel attest their understanding of the entire document, appendices included.

This IPEP will be in effect from the signing thereof until completion of the IV&V efforts for the Project or until terminated at the request of the NASA IV&V Program or the Project.

1.2 Intended Audience

{This section should be tailored to each individual Project. The "audience" in this section will reflect who is on the signatory page and on Figure 3-1, the IV&V – Project Interfaces diagram}.

The intended audience of this document includes NASA IV&V Program staff, particularly the NASA IV&V Program Manager, IV&V Office (IVVO) management, and the IV&V Team; Project personnel, particularly the Project Manager, IV&V <Point of Contact (POC)>, and <Chief Safety Officer (CSO) >; Safety and Mission Assurance (SMA), and Information Security personnel. *{Tailor out any aforementioned text if not applicable.}*

1.3 Document Organization

The IPEP is divided into two major parts: the document body and the appendices. The document body describes the overall IV&V project and defines the basic agreements for the partnership between the IV&V Team and the Project. Once coordinated and approved, the basic agreements in the document body are not expected to change.

The second part of the document, the appendices, focuses on the fiscal year activities for the IV&V efforts. The appendices contain data that are more dynamic in nature and are expected to change over the course of the Project. The appendices include the results of, or a reference to, the IV&V Heritage Review, IV&V Portfolio Based Risk Assessment (PBRA) data and subsequent Risk Based Assessments (RBA), and detailed information for each planned execution year, including items such as IV&V goals and objectives, schedule, and risks.

2 IV&V Overview

2.1 IV&V Goals and Objectives

{This section describes at a high level what the IV&V efforts are trying to accomplish overall for the mission. Specific goals and objectives for each of the fiscal years are identified in the appendices}.

The IV&V Team will ascertain the “goodness of product” for the Project’s safety and mission critical software. The IV&V Team will provide objective evidence and recommendations to increase the assurance that the software will operate reliably and safely in support of critical capabilities in the expected operating environment under nominal and defined off-nominal conditions. The IV&V Team will document any identified issues and risks to this assurance and will work with the Project to advance these issues and risks to resolution.

Specific IV&V project assurance goals and objectives for each fiscal year are identified in the appendices.

2.2 IV&V Approach

The IV&V Team functions technically, managerially, and financially independent of the Project. The IV&V approach will consist of validation- and verification-related analyses. Validation and verification are described further below, including the artifacts generally required for specific analysis objectives.

Validation-related analyses strive to assure the system software satisfies the user’s capability needs under operational conditions. These analyses evaluate the attributes, features, and qualities exhibited by the Project’s development artifacts for each selected critical capability, in the context of the following *three questions* defined in NASA IV&V SLP IVV 09-1:

- 1) Will the software do what it is supposed to do?
- 2) Will the software not do what it is not supposed to do?
- 3) Will the software respond appropriately to adverse conditions?

Verification-related analyses determine whether the products of each development activity are of high quality (e.g., are clear, consistent, verifiable, correct, and complete) and fulfill the requirements or conditions imposed by a previous development activity.

Specific analyses that the IV&V Team may perform include verification and validation using the following types of Project artifacts: Concept Documentation, Requirements Documentation, Design Documentation, Test Documentation, Implementation, Security Documentation, and Operations and Maintenance Documentation. The analyses may examine software-associated aspects of cross-program interfaces, control centers, or major communication links to include command and data handling capabilities. The IV&V Team may also perform independent testing using simulators, test environments or other test systems provided by the IV&V Program or the Project.

Examples of artifacts the IV&V Team needs to support verification and validation related analyses are listed in Table 2-1, below. In the event any of these artifacts cannot be provided to the IV&V Team, and/or the IV&V analyses are required to be performed on-site at the development organization, the IV&V PM and the IV&V <POC> will closely coordinate any impacts and document any risks to the performance of the IV&V efforts. The IV&V Team does not drive or mandate the creation of specific software artifacts. The IV&V Team will work with available information and content in most formats, as long as the artifacts provided include the data necessary to verify and validate the developer’s software and draw credible assurance conclusions on the software’s mission suitability.

Results of the verification and validation will serve as a basis for assessing the goodness of the system software considering the Project’s mission success criteria and the software’s ability to perform or support expected system and software behaviors for critical capabilities.

Typical outputs of the verification and validation related analyses will include requirements analysis reports, test design analysis reports, build analysis reports, and issues and risks. Refer to Section 4 of this document for additional information on these products.

For additional information regarding verification and validation related analyses, see NASA IV&V System Level Procedure (SLP) [IVV 09-1](#), *Independent Verification and Validation Technical Framework*.

{Modify the data in this table to reflect the targeted artifacts for your Project.}

Table 2-1: Project Targeted Verification & Validation Artifacts

Artifact Name	Need/Applicable Analysis
Operations Concept Document/Data	Verify and Validate Concept Documentation
Early concept/design review documentation/data	Verify and Validate Concept Documentation
Level 1 requirements	Verify and Validate Requirements
Mission Requirements Document	Verify and Validate Requirements
Spacecraft Element Requirements Document	Verify and Validate Requirements
Software Requirements Document	Verify and Validate Requirements
Interface Requirements Documents	Verify and Validate Requirements
Traceability Related Data (L2 – L5)	Verify and Validate Requirements / Verify and Validate Test Documentation
Hazard Analyses (PHA, FTAs, etc.)	Verify and Validate Requirements / Verify and Validate Test Documentation
System Test Plan	Verify and Validate Test Documentation
System Test Cases	Verify and Validate Test Documentation
Build Level Test Plan	Verify and Validate Test Documentation
Build Level Test Cases	Verify and Validate Test Documentation
Test Scripts	Verify and Validate Test Documentation
Integration Test Plans	Verify and Validate Test Documentation

Artifact Name	Need/Applicable Analysis
Integration Test Cases	Verify and Validate Test Documentation
Traceability related data (showing traceability from requirements to test cases)	Verify and Validate Test Documentation
Software Design Documentation	Verify and Validate Design
Software Design Models	Verify and Validate Design
Source Code	Verify and Validate Implementation
Software Build delivery/release packages/Version Description documentation/data	Verify and Validate Implementation
Test results (at varying levels including build level, integration level and system level)	Verify and Validate Implementation
Discrepancy reports from test activities	Verify and Validate Implementation
Traceability related data (showing traceability from requirements to design – to code to test)	Verify and Validate Test Documentation
Compile and build procedures	Verify and Validate Implementation
Build environments	Verify and Validate Implementation
Test environment resources (e.g., simulators, emulators, and supporting configuration items/data and tools)	Verify and Validate Implementation
System Security Plan	Verify and Validate Security Posture
Security CONOPS	Verify and Validate Security Posture
Software Security Requirements (if separate)	Verify and Validate Security Posture
Security Design and Architecture	Verify and Validate Security Posture
System's FIPS-199 Classification	Verify and Validate Security Posture
System's FIPS-200 Classification	Verify and Validate Security Posture
System Security Test Plan (if separate)	Verify and Validate Security Posture
System Security Test Cases (if separate)	Verify and Validate Security Posture
Threat Assessments	Verify and Validate Security Posture
Project Protection Plan	Verify and Validate Security Posture

2.3 IV&V Focus

As part of Software Assurance, IV&V plays an important role in the overall software risk mitigation strategy applied throughout the entire software lifecycle to improve the safety, reliability, and quality of software systems. To understand the risk profile, IV&V performs an independent software risk assessment to satisfy the following two objectives:

1. Create a portfolio to support prioritization of technical scope across all IV&V projects
2. Create a project-specific view to support planning and scoping of IV&V work on each individual IV&V project

The IV&V Team uses the PBRA process to assess the required system capabilities for which software contributes, in terms of impact of a defect and likelihood of a defect. The result of this assessment is an overall rating for each capability that is mapped using a 5x5 risk matrix to

prioritize the IV&V efforts within a particular IV&V project. This prioritization ensures application of IV&V resources to the most critical software capabilities.

The RBA process is used to select critical software entities (e.g., CSCIs) to further plan and scope the IV&V project. The entity-to-capability mapping produced by this phase provides a view of the system that serves as a useful tool for discussing and deciding where to apply IV&V effort.

The IV&V Team will share the PBRA and RBA results with Project and Agency stakeholders. Input and feedback on this data from the Project is encouraged. The IV&V Team will revisit the assessment ratings for the Project every six months (or more frequently, if warranted), and any changes to this data will be communicated to the Project. PBRA results are provided in Appendix A, and RBA results are provided in Appendix B. For additional information on the PBRA and RBA process, see NASA IV&V guidelines for the PBRA and RBA Process, [S3106](#).

3 Roles, Responsibilities, and Interfaces

To facilitate successful execution of the IV&V efforts as described in this plan, various roles, responsibilities, and interfaces are maintained. These roles and responsibilities can be described in terms of personnel within the NASA IV&V Program and personnel within the Project. The subsections below describe these roles and responsibilities. Figure 3-1 depicts the interfaces associated with these roles.

{The generalized diagram in Figure 3-1 should be tailored to reflect the interfaces for your Project and reflect the characteristics of your Project. Also, update Section 3.3 Project-related text below if additional Project personnel are on the signature page of the IPEP and/or have any roles pertaining to the IV&V efforts.}

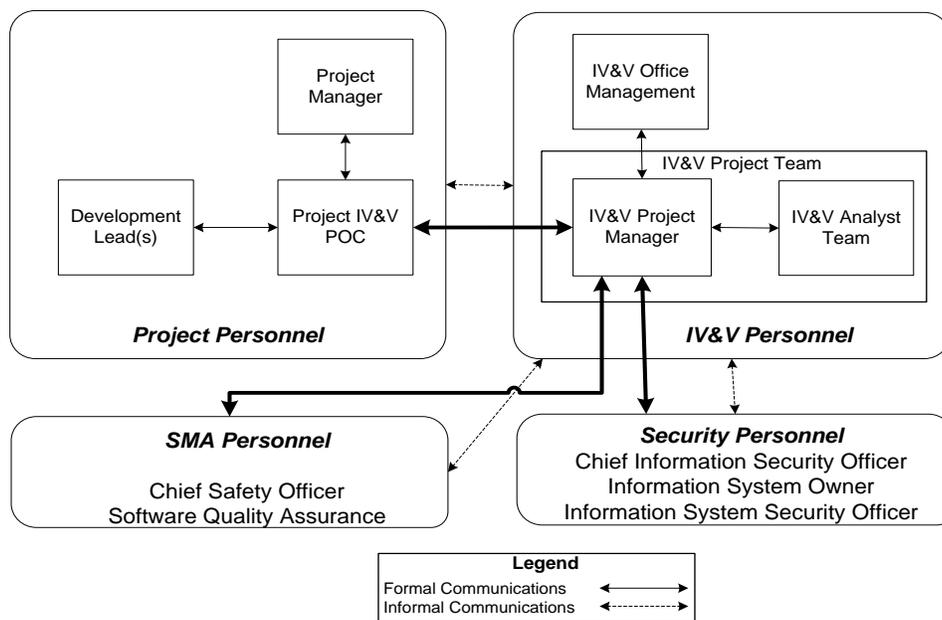


Figure 3-1 – IV&V Team and Project Interfaces

3.1 IV&V Program

3.1.1 Research Support

The NASA IV&V Program conducts research in various areas that directly contribute to the efficiency and effectiveness of IV&V. All Project data will be closely protected and not released outside the NASA IV&V Program and its research contractors. No proprietary Project data will be used to support NASA IV&V research unless there is a non-disclosure agreement in place between the NASA IV&V researchers and the owner of the proprietary data. The Project agrees that non-proprietary, non-export-controlled, non-SBU Project data may be used to support software IV&V-related research. The NASA IV&V Program agrees that any related research will not affect Project personnel or resources. The NASA IV&V Program agrees not to publish or allow publication of any research document that can be referenced back to the Project without specific, prior written approval from the Project.

3.1.2 IV&V Metrics Support

The NASA IV&V Program strives to ascertain the value and effectiveness of the IV&V efforts. Some of these efforts require the comparison of software issues identified by IV&V and software issues identified by the Project, as well as investigating post-launch software anomalies. The IV&V Team may request data from the Project in support of these efforts. The Project, subject to the IV&V <POC's> discretion, will provide access to the data, or the actual data necessary to support these efforts. The IV&V PM will work with the IV&V <POC> to identify the specific data of interest, but it is expected that this data will be of the following nature:

- (a) Software issues: description of the software issues identified by the developers, including issue type, phase introduced, phase found, relevant Computer Software Configuration Item (CSCI), severity of issue, and efforts to fix if available
- (b) Post-launch software anomalies: description of the software issue, overall impact, relevant CSCI, root or contributing cause, associated resolution to the defect anomaly

Access to the data can be in the form of access to Project or developer problem reporting systems, post-launch anomaly tracking systems or via periodic reports delivered to the IV&V PM. Any access to existing systems would be on a non-interfering basis to minimize impact to the Project.

3.2 IV&V Team

{Tailor the text below to include a Deputy IV&V PM, etc. to reflect the organizational structure for your Project; ensure that the text below is consistent with the data in Figure 3-1.}

The IV&V Team primarily consists of an IV&V PM and an IV&V Analyst Team. The IV&V PM serves as the primary interface with the Project in support of the IV&V efforts. The IV&V PM is responsible for the overall leadership and direction of the IV&V efforts. This IPEP is prepared and maintained by the IV&V PM. The IV&V PM coordinates the creation and maintenance of this document with affected individuals and organizations (within the NASA IV&V Program as well as with the Project). The IV&V PM is responsible for establishing the goals and objectives of the IV&V efforts, performing the PBRA and subsequent RBAs, performing project management, tracking and oversight, and conducting risk management of the IV&V efforts. The IV&V PM is responsible for ensuring that the commitments with the Project as defined in this plan are met.

The IV&V Analyst Team performs the verification- and validation-related analysis. At times and at the request of the IV&V PM, the IV&V analysts may interface with the Project. Informal interfaces between IV&V Personnel, including members of the IV&V Analyst Team, and Project, SMA, and Information Security personnel are indicated by the dashed lines in Figure 3-1. Development of informal interfaces is encouraged to enhance communications and resolve concerns and questions at the lowest possible level.

A variety of different NASA IV&V Program groups may support the IV&V Team, and personnel from these groups may interact with Project, SMA, and Security personnel, as coordinated by the IV&V PM. Supporting groups may include the NASA IV&V Program Independent Test Capability (ITC) team and the IV&V Software Assurance and Tools team (SWAT).

3.3 Project Personnel

{Tailor the text below to reflect the organizational structure and roles that have been established and/are applicable for your Project or development Project personnel; ensure that the text below is consistent with the data in Figure 3-1}.

The Project will provide an IV&V <POC> for formal interactions between the IV&V Team and the Project. The Project IV&V <POC> will facilitate the IV&V tasks to be performed through coordination between Project personnel, the Project's Safety and Mission Assurance (SMA) personnel, the development leads, and the IV&V PM.

The Project will provide the IV&V Team the necessary interfaces, Project development data and documentation, and any other negotiated resources to perform the IV&V tasks. The Project will provide such data and documentation as the information is made available to the Project. The Project will provide draft and final versions of IV&V-requested development artifacts. It is expected that many of the development artifacts necessary to perform the IV&V analysis will be formal deliverables. However, in some cases non-deliverable or informal documentation (e.g., Software Development Folders, incremental pre-release builds, etc.) may be needed to support the IV&V analysis. In such cases, the Project IV&V <POC> will make these items available on a case-by-case basis after taking into consideration various factors including but not limited to overall impact on the Project. The incremental pre-release builds, in particular, are often necessary for the IV&V Team to achieve in-phase identification of issues. While not required, electronic access to Project data and documentation is preferred (e.g., requirement tracing tools and databases, issue tracking systems, document repositories, risk management system, etc).

The Project, through the IV&V <POC>, is responsible for working with the IV&V Team to resolve issues and risks identified by the IV&V Team.

The Project, through the IV&V <POC>, will support any research and metrics related initiatives as described above.

For these IV&V efforts, applicable contact information is identified in Tables 3-1 and 3-2 below.

Table 3-1 – IV&V Team Contact Information

NASA IV&V Program		
Position	Name	Contact Information
NASA IV&V Director	<Director Name>	<Director contact phone number> <Director contact email address>
NASA IV&V Deputy Director	<Deputy Director Name>	<Deputy Director contact phone number> <Deputy Director contact email address>
NASA IV&V Associate Director	<Associate Director Name>	<Associate Director contact phone number> < Associate Director contact email address>
IV&V Office Lead	<IV&V Office Lead Name>	<IV&V Office Lead contact phone number> <IV&V Office Lead contact email address>
IV&V Project Manager	<IV&V PM Name>	<PM contact phone number> <PM contact email address>
IV&V Deputy Project Manager <i>{if assigned}</i>	<IV&V Deputy PM Name>	<Deputy contact phone number> <Deputy contact email address>

Table 3-2 – Project Contact Information

Project		
Position/Role	Name	Contact Information
Project Manager	<PM Name>	<PM contact phone number> <PM contact email address>
IV&V <Point of Contact>	<IV&V POC Name>	<POC contact phone number> <POC contact email address>
Chief Safety Officer or Mission Assurance Manager <i>{if applicable}</i>	<CSO Name>	<CSO/MAM contact phone number> <CSO/MAM contact email address>

Project		
Position/Role	Name	Contact Information
Software Quality Assurance (SQA) Representative <i>{if applicable}</i>	<SQA Rep. Name>	<SQA contact phone number> <SQA contact email address>
Software Development Lead <i>{if applicable}</i>	<SDL Name>	<SDL contact phone number> <SDL contact email address>
Chief Information Security Officer <i>{if applicable}</i>	<CISO Name>	<CISO contact phone number> <CISO contact email address>
Information System Owner <i>{if applicable}</i>	<ISO Name>	<ISO contact phone number> <ISO contact email address>
Information System Security Officer <i>{if applicable}</i>	<ISSO Name>	<ISSO contact phone number> <ISSO contact email address>

4 IV&V Products and Communication and Reporting Methods

The IV&V Team generates various products and utilizes various communication and reporting methods throughout the lifecycle. The subsections below describe the IV&V products and associated communication and reporting methods further.

4.1 IV&V Products

4.1.1 Analysis Reports

Over the course of the lifecycle, the IV&V Team may generate analysis reports that document the results of the analyses performed. These reports will typically describe what the IV&V Team analyzed (Project artifacts), a high-level description of the process, approach, and tools used (if applicable), and associated results. The IV&V Team will provide the analysis reports to the Project as defined in the Appendix for each fiscal year.

4.1.2 Lifecycle Review Presentations

Throughout the lifecycle, the IV&V Team supports formal Project milestone reviews (e.g., a Preliminary Design Review, a Critical Design Review (CDR), etc.) by providing information that portrays the IV&V assurance status, including overall goodness of product data, at the time of the review. At a minimum, and as required by the NASA Agency's Chief SMA Officer, the IV&V Team will present status of the IV&V efforts and associated recommendations at the Safety and Mission Success Review (SMSR).

4.1.3 Technical Issue Memorandums

A Technical Issue Memorandum (TIM) is the formal mechanism the IV&V Team uses to document one or more instances of a defect or defects (i.e., issue) identified within a development artifact, and subsequently formally communicate defects to the Project. Each TIM has a documented impact and is assigned a severity rating between 1 (highest severity) and 5 (lowest severity) as defined in Table 4-2. TIMs of severity rating 1-3 require a formal disposition by the Project and must be verified to have been addressed prior to closure. TIMs of severity rating 4 or 5 may be reviewed by the Project, but a formal response is not required (i.e., may transition directly to the "Not To Be Verified" state in IV&V Program issue tracking system). Resolving severity rating 4 and 5 TIMs, nonetheless, will certainly improve the quality of the Project's software and reduce or eliminate risks associated with maintenance of the software product.

TIM Resolution Path: The Project will review the TIM as provided by the IV&V Team and respond in a timely manner. Timing may require coordination on a case-by-case basis. In general, it is best if TIM can be reviewed and responded to within a couple of weeks. Timely Project review and response is important to avoid propagation of defects into subsequent Project products, to prevent incorrect IV&V reporting (e.g., to Office of Safety and Mission Assurance (OSMA) and other NASA IV&V Program stakeholders), and to minimize IV&V rework.

If the Project concurs that a TIM is legitimate, the Project will propose a solution or formally accept the risk of not resolving the issue. IV&V does not advocate for the acceptance of risk associated with Severity 1 or 2 TIMs. When the Project identifies a plan to fix the defect, the TIM will be put in the “To Be Verified” state. After the defect is resolved, the Project will notify the IV&V Team that the corrective action has been made and will provide the appropriate evidence (e.g., updated development artifacts, etc.) to the IV&V Team for verification and subsequent closure of the TIM. If verification of the corrective action cannot be completed, the IV&V Team will request additional information from the Project. If the Project accepts the risk of not resolving the TIM, the TIM will be put in the “Project Accepts Risk” state.

If there is a dispute at any time in the issue resolution process, the TIM may be placed in an “In Dispute” state, at which time the Project and IV&V Team can continue dialog on the TIM. Subsequent to these discussions, the TIM may be withdrawn, placed in the “Project Accepts Risk” state, or reverted to the “To Be Verified” state.

If the Project does not concur a TIM is legitimate, the Project will provide appropriate data and/or explanation to support this conclusion. The IV&V Team will review and consider this data and if. If the IV&V Team agrees, the TIM will be withdrawn. If the IV&V Team does not agree, additional dialog and discussion between the Project and IV&V Team may be required and an appropriate course of action will be determined.

Table 4-2: TIM Severity Rating and Description¹

Severity	Capability Affected	Success Criteria	Safety	Test	Cost & Schedule	Other
1 Catastrophic	Loss of an essential capability OR Complete loss of mission critical asset	Inability to achieve minimum mission success criteria	Causes loss of life or injury	N/A	N/A	N/A
2 Critical	Degradation of an essential capability OR Damage/destruction to mission asset which affects performance	Impact to the accomplishment of a mission objective	N/A	Essential capability not tested	Significant cost increases or schedule slip	Significant reduction to requirements margins or design margins
3 Moderate	Degradation of system dependability OR Loss of a non-essential capability	Impact to the accomplishment of extended/optional mission objectives	N/A	Essential capability inadequately tested	Cost or schedule impact resulting from redesign, reimplementation, and/or retest	Degradation of an essential capability or inability to accomplish mission objective, but with a known workaround
4 Minor	Degradation of a non-essential capability	N/A	N/A	Non-essential capability inadequately tested	Defect impacting maintainability on current mission or reuse on future missions	Creates inconvenience for operators, crew or other projects' personnel
5 Communications Or Editorial	Defect impacting documentation and communication clarity					

¹ Source: [S3105, Guidelines for Writing IV&V TIMs](#)

4.1.4 Risks

By conducting IV&V analysis, the IV&V Team may become aware of circumstances or information that represents a potential undesirable event for the Project. The IV&V Team will document such items as risks and will formally communicate these risks to the Project. The IV&V Team will assess all risks based on the likelihood and consequence of the undesired event using the Project's likelihood and consequence ranking criteria (as defined in the Project's risk management plan). The IV&V Team may also provide recommendations to eliminate, reduce, or mitigate the risks. The IV&V Team will coordinate all risks with the Project prior to formal submission. To facilitate the submission of risks, the IV&V Team may request access to the Project's Risk Management System (RMS) and the IV&V Team and IV&V <POC> will work together to determine the appropriate level of access (e.g., read-only, write, none) to the RMS.

Typically, Projects retain residual risks throughout the lifecycle. As such, the IV&V Team may need to assess the Project's residual risks. At minimum, and as required by the <Chief SMA Officer>, the IV&V Team will evaluate residual risk data as provided by the Project in preparation for the SMSR. The IV&V Team will communicate their stance with regards to such residual risk data to the Project prior to the SMSR.

Risk Resolution Path: The Project will review risks as provided by the IV&V PM. If the Project agrees with the nature of the risk they may choose to take ownership of the risk. Subsequently, the Project will document the risk and associated mitigation plan(s) in the Project's RMS. It is expected that the Project actively manages, tracks, and mitigates such risk. The IV&V Team will monitor the progress of these activities until the risk is closed. This monitoring may be performed independently or via the Project providing status data to the IV&V Team. If the IV&V Team determines that the risk is not being actively managed, the IV&V Team will discuss this with the Project IV&V <POC> and determine an appropriate course of action.

If the Project decides not to accept, mitigate, and manage a risk, the Project will provide appropriate information to support this conclusion. The IV&V Team will review this information and, if the IV&V Team is in agreement, they will withdraw the risk. If the IV&V Team is not in agreement, additional dialog between the Project and IV&V Team may be required and an appropriate course of action will be determined.

4.1.5 Item Tracking, Monitoring, and Escalation

All data such as issues and risks are recorded and provided to the Project as they are identified and/or as per an agreed-to schedule. The IV&V Team will evaluate Project responses to this data and update the status of this data in terms of tracking towards resolution in the appropriate NASA IV&V Program repository. In addition, this "goodness of product" data will be documented in other IV&V products including but not limited to lifecycle review presentations, analysis reports and recurring or ad hoc status reports as applicable.

{Modify this section to reflect the escalation chain that is appropriate for your Project}.

Given the reporting data mentioned above, any areas of disagreement regarding this data that cannot be resolved between the IV&V Team and the Project within an appropriate period, the

IV&V PM will elevate the issue to IV&V Office Management. The IV&V PM will ensure that the Project is aware that the issue is being elevated. The final level of resolution will be the Program Management Council (PMC) responsible for the Project.

4.2 IV&V Communication and Reporting Methods

Communications and reporting methods between the IV&V Team and the Project occur via both formal and informal channels. Formal communication and reporting methods include delivery of IV&V analysis reports and associated technical data, IV&V briefings at milestone reviews, and dialog between the IV&V Team and Project regarding scope, priorities, access to resources, etc. consistent with this plan. Informal communications and reporting methods include recurring teleconferences and tag-ups between the IV&V Team and Project IVV <POC>, requests for and delivery of development artifacts, technical discussion on IV&V analysis results to facilitate resolution of IV&V issues and risks.

4.2.1 Lifecycle Review Presentations

The IV&V PM will provide IV&V status data and associated results of the IV&V efforts at various Project milestone reviews as defined in Table 4-3 below. The IV&V Team will communicate and coordinate the overall content of the presentation with the Project prior to the actual review.

{Tailor the data in this table to reflect what the requirements are for your Project based on customer discussion.}

Table 4-3: Milestone Review IV&V Presentations

Milestone Review	Project Recipient	Input Due
CSCI level reviews (for CSCIs being assessed)	IV&V <POC>	As required by the Project
Mission Reviews (i.e. PDR, CDR, MRR, LRR, SMSR)	IV&V <POC>	As required by the Project

4.2.2 Agency/Mission Directorate/Center Management Briefings

Throughout the course of the lifecycle, the IV&V Team is required and/or requested to present IV&V status to various stakeholders including but not limited to Center Management and the Mission Directorates, etc. Given that the IV&V Program is GSFC Code 180.0, IV&V does provide input to the GSFC Monthly Status Reviews for all projects receiving services from the IV&V Program. The IV&V Team will communicate and coordinate the overall content of these presentations with the Project prior to the actual review as defined in Table 4-4 below.

{Tailor the data in this table to reflect what the requirements are for your Project based on customer discussion. Use working days unless there is a true requirement for calendar days to be used, e.g., a contractual or legal requirement. Regardless, be specific as to the type of days intended.}

Table 4-4: Additional Reporting Events

Milestone Review	Project Recipient	Input Due
GSFC Monthly Status Review (MSR)	IV&V <POC>	5 working days prior to review
IV&V Board of Advisor (IBA) Semi-Annual Briefings	IV&V <POC>	5 working days prior to review

4.2.3 Routine Tag-ups

The IV&V Team will work with Project personnel to establish routine tag-ups to discuss overall IV&V status, development artifacts requests, results of IV&V analyses (issues and risks), status of Project schedule and artifacts, resolution of IV&V issues and risks, and delivery of formal IV&V reports, etc. Such tag-ups may occur on a weekly, bi-weekly, or monthly basis as agreed to by both parties. These routine tag-ups represent the preferred method for communicating and resolving any issues and/or risks that the IV&V Team has identified.

Appendix A: IV&V PBRA Results

Figure A-1 below depicts the PBRA results for this mission. The supporting rationale for this data is maintained by the IV&V PM and is available upon request. Typically, capabilities that fall into the green category will not receive IV&V analysis. Capabilities in the red category will typically receive IV&V, as these represent the most critical capabilities of the system. Capabilities that are in the yellow category may receive IV&V pending funding availability and other factors.

{Replace the data in Figure A-1 with data for your particular Project and tailor subsequent content as necessary. The intent of this appendix is to communicate coverage to the readers of this document and as such, this content may be tailored as needed to best communicate the coverage for your project. Ensure that the content is legible and digestible by the reader. If you project has an exceptionally large number of capabilities the use of a table may be more appropriate than utilization of the 5x5 matrix. Consult the Process Owner if you have any questions regarding how to best represent the PBRA results for your project. }

Figure A-1 PBRA Results

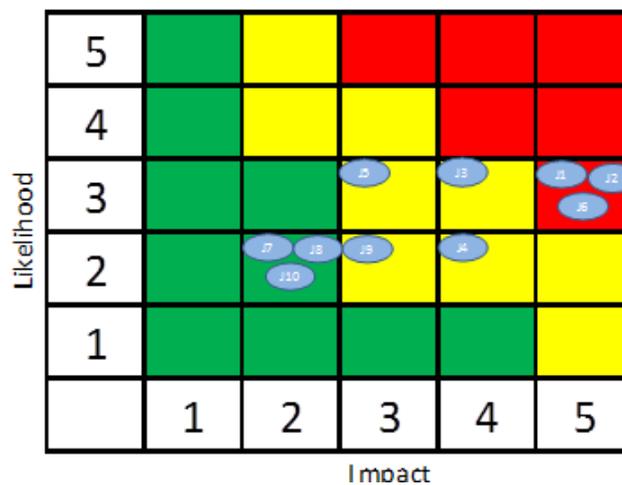


Table A-1 PBRA Results²

Risk Score Summary			
	Capability	Impact	Likelihood
J1	Perform Launch Operations	5	3
J2	Deployment & Traj Correction Maneuvers	5	3
J3	Cruise & Commissioning	4	3
J4	Perform Real-Time Operations	4	2
J5	Perform Event Driven Operations	3	3
J6	Perform Onboard Fault Mgmt	5	3

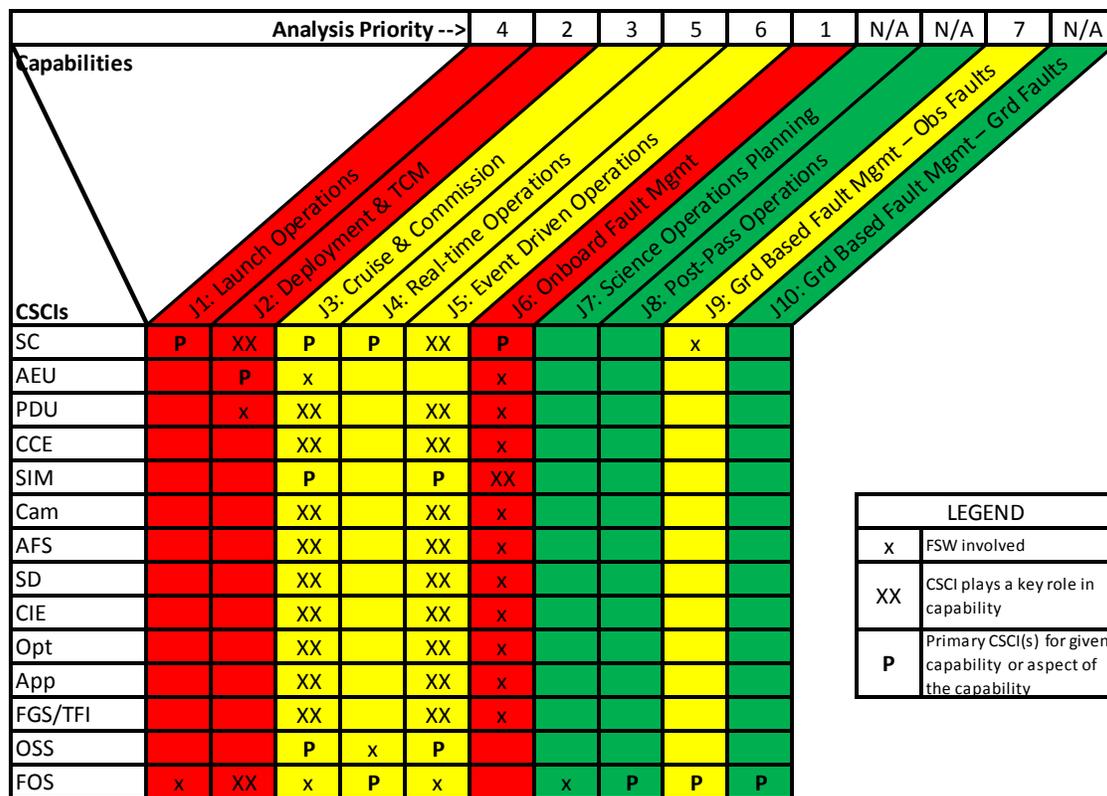
J7	Perform Science Operations Planning	2	2
J8	Perform Post-Pass Operations	2	2
J9	Perform Grd Based Fault Mgmt for Observatory Faults	3	3
J10	Perform Grd Based Fault Mgmt for Grd Based Faults	2	2

Appendix B: IV&V RBA Results

*{The purpose of this section is to communicate the RBA results and provide a bridge between the top level capabilities and the entities for a given project **and** to communicate the focus areas for IV&V. As with Appendix A, the author of the IPEP may tailor this section to best communicate the RBA results for his or her project. Figure B-1 and Table B-1 below may not be the best mechanism to use for a project that has a large number of capabilities and entities and thus other options may need to be considered to meet the purpose of this section. For new Projects that may not have determined where IV&V will focus effort yet, simply note “To Be Provided at a later time.” Text below is from a sample project – tailor as needed}*

The process for prioritization of IV&V resources starts with the PBRA process, which is applied to mission capabilities (result shown in Appendix A). The next step is the RBA process, which extends risk assessment to the software components that implement the system behaviors necessary to accomplish mission capabilities. Figure B-1 shows the resulting mapping of <Project Name> CSCIs vs. PBRA Capabilities.

Figure B-1 –Capability to CSCI Mapping and Analysis Priority



{The information in Table B-1, as well as the introductory text, reflects the assurance approach for an example project and should be tailored to represent the approach for your Project. This text does not represent IV&V Program level guidance, but rather is the result of the determined Assurance Strategy and Design for an example project. Please tailor as necessary.}

Table B-1 lists the result of prioritization analysis for the components of CSCIs and an indication of those that are expected to have development work in FY15. Components in “gray” were not fully rated because no development work or IV&V analysis work is expected in FY15. Components in “red” are high priority, “yellow” are medium priority, and “green” are low priority.

The nominal approach to IV&V analysis per priority category is

- High-priority/red components – full lifecycle IV&V analysis (requirements, design, code, and test artifacts) with emphasis on functions that support red and yellow PBRA capabilities
- Medium-priority/yellow components – requirements analysis, test analysis, and code quality assessment (e.g., via static code analysis); for yellow components with high RBA impact scores (>3) or areas where latent risk or concerns were identified by other analysis tasks or data, targeted design and code analysis will also be performed
- Low-priority/green components – no IV&V analysis unless warranted by latent risk/concerns identified by other analysis tasks or data

Table B-1 –CSCI/CSC RBA Analysis Priority

CSCI/Subsystem	CSC/Component	Work in FY15	Impact	Likelihood
SC				
	SC FSW.Command & Data Handling (C&DH)			
	SC FSW. Support			
	SC FSW.Memory			
	SC FSW. Management			
	SC FSW.Recorder			
	SC FSW.Attitude Control System (ACS)	x	5	4
	SC FSW.Electrical Power Systems (EPS)		5	3
	SC FSW.Thermal Control System (TCS)	x	5	2
	SC FSW. Fault Management		5	3
	SC FSW.Launch			
	SC FSW. Command Processing		5	3
	SC FSW. Interface Module			
Deployment Control				
	DC FSW.Boot Processing	x	5	2
	DC FSW.Operation Processing	x	5	2
	DC FSW.Input/Output Processing	x	5	1
	DC FSW.Control Processing	x	5	1
	DC FSW.Communications Processing	x	5	1
	DC FSW.Utilities Processing	x	5	2
Instrument FSW				
	Inst FSW.Startup		4	1

{The information below regarding IV&V Focus is intended to provide additional context for the previously communicated priorities. This data is provided as an example and may be tailored as necessary. This data was generated for an example science project and may need to be revised for a project where human safety factors are a concern.}

IV&V Focus

IV&V focus areas identify software capabilities that drive risk-based IV&V assurance for the <Project Name> mission. These focus areas are aligned with the criteria that are used for the PBRA and RBA assessments and are used to define assurance objectives within the software components identified by the RBA as receiving IV&V analysis. Higher priority focus areas receive a higher level of rigor of IV&V analysis. Focus areas in priority order are:

- 1. Mission Preserving Capabilities** – This focus area includes the software capabilities designed to perform operations that must work in order for the observatory to retain the ability of achieving any of its mission objectives, preventing permanent loss of the observatory or its ability to conduct the mission. Examples include power, communications, deployments, trajectory corrections, coarse attitude control for safe mode, in-flight software updates, command, telemetry, and fault management for catastrophic hazards.
- 2. Mission Objectives Capabilities** – This focus area includes the software capabilities designed to perform operations that must work in order to achieve any mission objectives or are designed to prevent the permanent loss of the capabilities needed to meet specific mission objectives. Examples include attitude control and fine guidance control for science operations, wave front sensing and control, science data acquisition, science instrument integrity, and core operations scripts automation.
- 3. Operational Continuity Capabilities** – This focus area includes the software capabilities that if they experienced failures, there would be a significant interruption to productive science operations.

Appendix C: IV&V Heritage Review & Applicable Lessons Learned

{Either include the Heritage Review document or identify the relevant document(s) and include a pointer to the location.

Include all applicable lessons learned from past mission(s), past IV&V experience, or from other Lessons Learned databases.}

Appendix D: Technical Scope & Rigor (TS&R)

*{Include the **TS&R** document for your particular Project or identify the relevant document(s) and include a link to the location.}*

Appendix E: Reference Documentation

{Include documents that were identified in this IPEP and any other relevant Project documentation. The purpose of this section is to identify locations and/or versions of documentation that is specified in the body of the IPEP.}

Table E-1: Relevant Documentation

Document	Title	Link or Date
IVV 09-1	Independent Verification and Validation Technical Framework	IVV 09-1
S3105	Guidelines for Writing IV&V TIMs	S3105
S3106	PBRA and RBA Process	S3106
NASA-STD-8719.13C	NASA Software Safety Standard	NASA-STD-8719.13C
NPR 8715.3C	NASA General Safety Program Requirements	NPR 8715.3C

For more information regarding the <Project name> mission, see the Project’s website at: <URL for Project’s website>.

Appendix F: Acronyms*{Add any mission specific or additional acronyms not already defined.}*

CAR	Corrective Action Report
CDR	Critical Design Review
CISO	Chief Information Security Officer
CONOPS	Concept of Operations
CSCI	Computer Software Configuration Item
CSO	Chief Safety Officer
FIPS	Federal Information Processing Standard
FTA	Fault Tree Analysis
FY	Fiscal Year
IPEP	IV&V Project Execution Plan
ISO	Information System Owner
ISSO	Information System Security Officer
ITC	Independent Test Capability
IBA	IV&V Board of Advisors
IV&V	Independent Verification and Validation
IVVO	Independent Verification and Validation Office
JWST	James Webb Space Telescope
LRR	Launch Readiness Review
MAM	Mission Assurance Manager
MRR	Mission Readiness Review
MSR	Monthly Status Review
NASA	National Aeronautics and Space Administration
NDA	Non-Disclosure Agreement
NODIS	NASA Online Directives Information System
NPR	NASA Procedural Requirements
OSMA	Office of Safety and Mission Assurance
PBRA	Portfolio Based Risk Assessment
PDR	Preliminary Design Review
PHA	Preliminary Hazard Analysis
PM	Project Manager
PMC	Program Management Council
POC	Point of Contact
RBA	Risk Based Assessment
RMS	Risk Management System
SBU	Sensitive But Unclassified
SDL	Software Development Lead
SLP	System Level Procedure
SMA	Safety and Mission Assurance
SMSR	Safety and Mission Success Review
SQA	Software Quality Assurance
SRR	System Readiness Review

STD	Standard
SWAT	Software Assurance and Tools
TIM	Technical Issue Memorandum
TS&R	Technical Scope & Rigor

Appendix G: Fiscal Year <XX> IV&V Summary

{This appendix should focus on identifying the goals and objectives of the IV&V efforts for the applicable FY, any known risks associated with the IV&V Team’s ability to achieve the identified goals/objectives, anticipated resources and associated costs. This data should be repeated in subsequent appendices for each of the remaining Fiscal Years; the data should be of higher fidelity for the current FY and decreasing in fidelity for the out-years.}

G.1 FY <XX> Assurance Goals and Objectives

{The intent of this section is to identify at a high level the assurance goals and objectives of the IV&V efforts for the applicable FY.}

G.2 FY <XX> Targeted External Milestones

{List the key development project milestones in text or tabular format. Depending on the development project, this may include milestones such as SRR, PDR, CDR, MRR, ORR, Launch Date, etc.}

Table G-1: Project FY <XX> Milestones

Key Milestone	Current Planned Date
SRR	mm/20yy
PDR	mm/20yy
Launch	mm/20yy

G.3 FY<XX> Internal Milestones

{List key internal milestones for the IV&V efforts in text or tabular format. These will vary depending on the project, but may include mid-year PBRA update, IV&V kickoff meeting, next year planning meeting with development Project, etc.}

Table G-2: IV&V FY <XX> Internal Milestones

Milestone	Current Planned Date
PBRA/RBA Update	mm/20yy
Checkpoint Review	mm/20yy
FY XX Planning	mm/20yy

G.4 FY <XX> Schedule

{Provide a snapshot or summary of the IV&V Schedule for the applicable FY efforts. Ensure that it is viewable (note that you may have to change the orientation of this page accordingly); OR include a link in the IV&V ECM that identifies the location of the schedule and the name of the file.}

G.5 FY <XX> Risks

{Provide a listing of risks that you perceive exist with the execution of your plan for the applicable year. This data only needs to be at the summary level as these risks will be managed via the IV&V Risk Review Board}.

Table G-3: IV&V Identified Risks

Risk Title	Risk Statement/Description

G.6 FY <XX> IV&V Technical Reports

{List specific technical reports planned for the fiscal year. For relative dates, use working days unless there is a true requirement for calendar days to be used, e.g., a contractual or legal requirement. Regardless, be specific as to the type of days intended.}

Table G-4: FY <XX> IV&V Technical Reports

Report Title or Scope	Delivery Date or timeframe
Requirements Analysis Report	mm/20yy
Build x.x Analysis Report	mm/20yy
Test Analysis Report	15 working days after activity completed

{Update Table of Contents once this document is completed}