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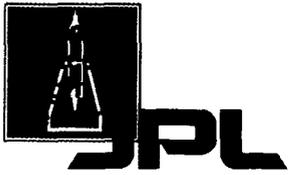
# **IV&V – a JPL Perspective**

**(Institutional Status and Lessons Learned)**

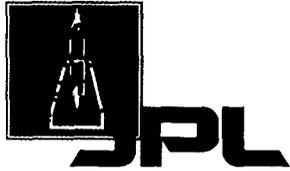
**Burton C Sigal**

**Manager, Software Assurance and IV&V  
Office of Safety and Mission Success**

**May 13-15, 2003**



- 
- **JPL has proactively taken an effective position in implementing institutional measures to support / implement the Administrator's call to "...better integrate IV&V into flight programs..."**
  - **JPL continues to update / integrate its IV&V activities into the JPL institutional infrastructure**



# Our Vision

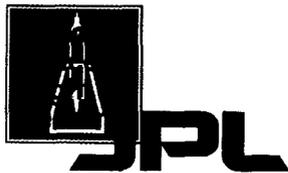


**JPL's approach to effectively implementing the Administrator's July 1999 call to better integrate IV&V has three main thrusts**

**Institutional – making it a part of how we do business**

**Project – what the various JPL stakeholders do**

**Management – active advocacy and support**



# Institutional



1. **Strategically, JPL felt it was necessary to provide institutional support and guidance for management emphasis, policy direction, and uniformity across projects. We developed a high level policy that was premised on a single JPL Mission Assurance point of contact (POC) to:**
  - a. coordinate all laboratory IV&V activities
  - b. provide guidance and interpretation for application of, and conformance to NASA and JPL policies
  - c. insure consistency of adherence and application across projects
  - d. interface with the agency Enterprises and Codes on IV&V issues
  - e. interface with the NASA IV&V Facility
  - f. provide alignment across support disciplines, e.g., software process, software assurance, etc.
  - g. develop lessons learned to better utilize IV&V services
  - h. provide alignment/support with the agency SWG and the JPL SQI project



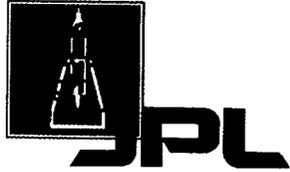
# Project

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## 2. Tactically, JPL developed, vetted, and released

- a. A requirement that all projects have a software process and product risk assessment that identifies risks and recommends project, SQA, and IV&V mitigations
- b. A Flight Project Practice that requires all projects to engage the IV&V Facility starting at AO/proposal response, continuing throughout the project life cycle utilizing the support of the JPL Mission Assurance IV&V POC
  1. Procedures for JPL IV&V activities
- c. An on-going set of IV&V briefings/trainings for Project Managers, PEMs, MAMs, CogEs, etc.
- d. A JPL/IV&V knowledge/experience base embodied in the JPL IV&V web page



# Management

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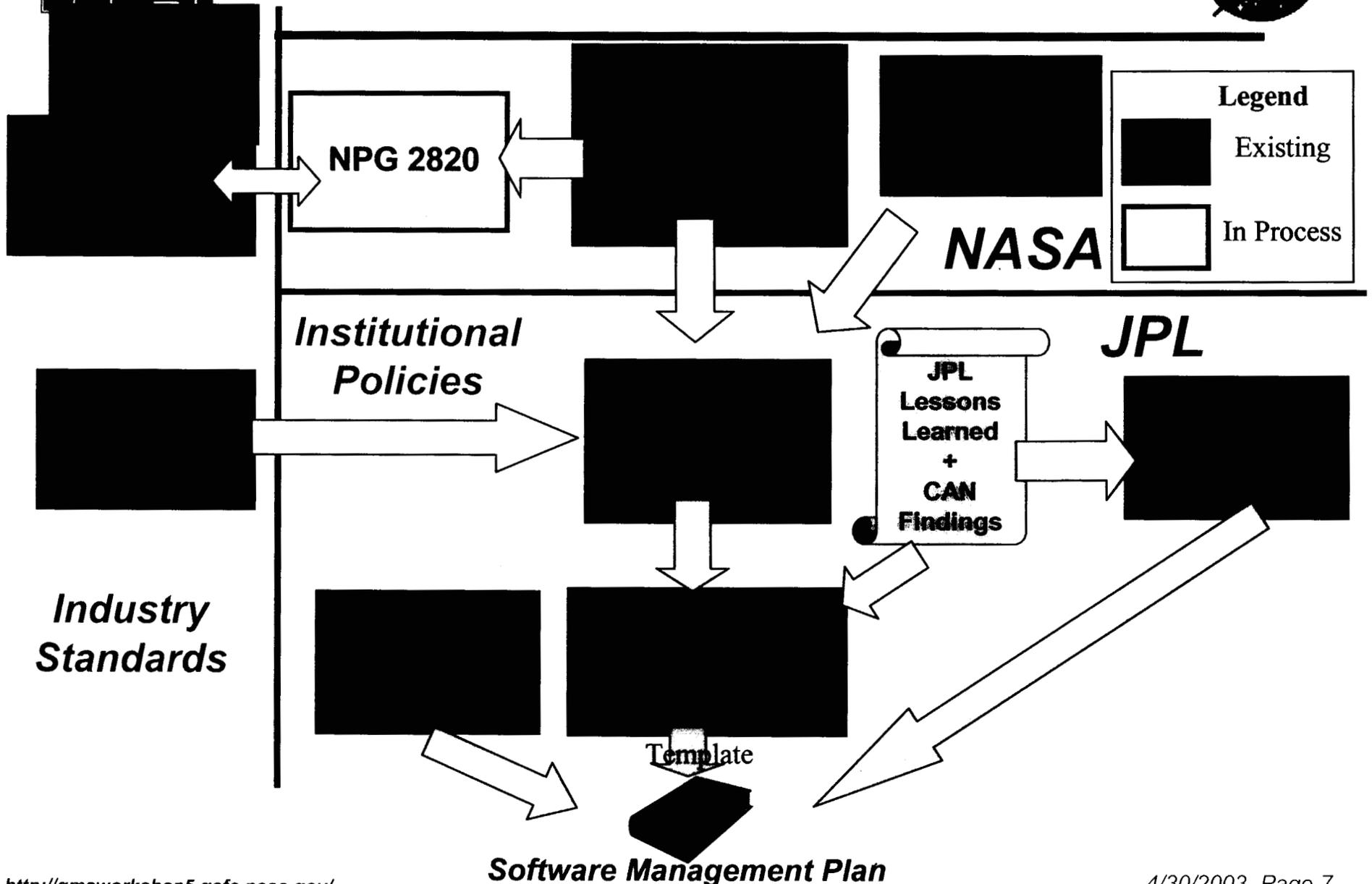


## 3. JPL Management endorses and supports these actions

- a. JPL requires PMs to perform SQA risk assessment, to follow **FPPs** (Flight Project Practices) and to report on status
- b. JPL requires the IV&V Facility to report at JPL Quarterly IV&V Status Reviews and project MMRs
- c. JPL is proactively proposing significant improvements to their IV&V process and is sponsoring a coordinated standardized approach with the Enterprises, Codes, Centers, and the NASA IV&V Facility
- d. JPL has been an invited participant on agency IV&V activities, e.g., NPD/NPG teams, agency oversight team IV&V assessment/interviews, etc.



# The Document Flowdown Process



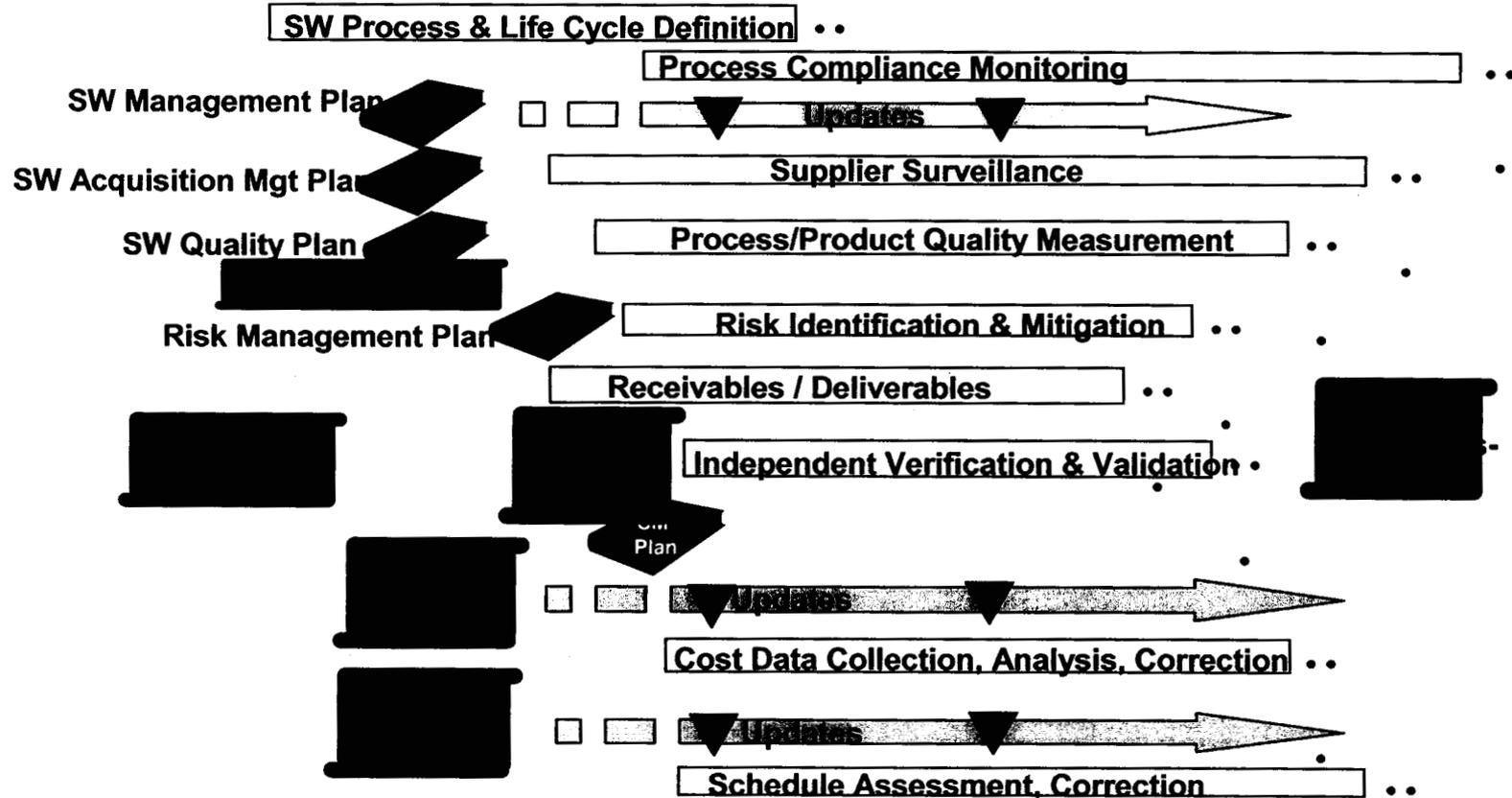


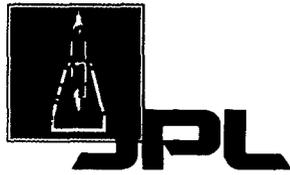
# Software Planning, Monitoring, and Control



FORMATION

IMPLEMENTATION





# Flight Project Practice (JPL Software IV&V Website)



Flight Project Practices, Rev. 2 Requirement - Netscape

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## 7.4 Software IV&V

### Preamble

NASA has determined that independent verification and validation (IV&V) of software, when required, will be managed and carried out by the NASA IV&V Facility. The NASA IV&V Facility provides an independent set of services to identify software risks and recommend mitigations.

### Practices

7.4.1 Projects developing and/or acquiring safety/mission critical flight software with a significant risk use software IV&V for identifying software risk, using *Establishing a Scope of Work with the NASA IV&V Facility* procedure. (To be supplied.)

7.4.2 Projects complete a software risk assessment based on NASA-defined criteria to determine if an independent assessment (IA) or IV&V is indicated. This determination is made prior to the PMSR, or prior to Step 2 for AO driven projects, and is subject to Director-for review.

7.4.3 If IV&V is warranted based on the foregoing determination, the project performs a software development process and product risk assessment. Then, in consultation with the NASA IV&V Facility, the project determines the appropriate level and scope of IV&V prior to subsystem software PDR.

7.4.4 The project manager arranges for software IV&V to be managed and performed by the NASA IV&V Facility. The resulting MOA is reviewed and approved by the GPMC.

*Note: Establishing a Scope of Work with the NASA IV&V Center has yet to be approved by the PEMC. Until then, waivers are not required for deviations.*

7.4.5 Projects report IV&V status at the GPMC reviews.

### Documents

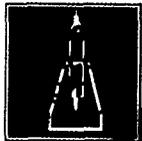


## Who Must Comply With This Procedure

This procedure applies to all Projects and Independent Division Tasks developing and/or acquiring safety/mission critical flight software.

### Steps

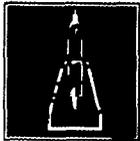
Actor	Action
JPL Mission Assurance POC (Point of Contact)	2.1 Identifies projects developing and/or acquiring safety/mission critical flight software ( <a href="http://rules.jpl.nasa.gov/cgi/doc-gw.pl?DocID=57272">http://rules.jpl.nasa.gov/cgi/doc-gw.pl?DocID=57272</a> ) and requests a project web site designator from NASA IV&V Facility. Note: this is to be completed for STEP1, STEP2, AO response or 1 year prior to PMSR.
Project Manager	2.2 Completes a self-assessment of software risk and failure consequence based on NASA –IV&V Facility defined criteria and submits results to JPL Mission Assurance POC. See: <a href="http://ivvcriteria.ivv.nasa.gov/">http://ivvcriteria.ivv.nasa.gov/</a>
Project Manager	2.3 Enters self-assessment data into IV&V web site 2.4 Schedules self-assessment results discussion telecon



# Establishing a Scope of Work with the NASA IV&V Facility



Who	Action
Project Manager, JPL Mission Assurance POC, IV&V Facility	2.5 Discuss self-assessment results for understanding, clarification, and agreement
IV&V Facility	2.6 Submits IV&V cost estimates for proposal/AO response or project planning
Project Manager	2.7 Requests Software Assurance software development process and product risk assessment six months prior to subsystem software PDR. See: <a href="http://rules.jpl.nasa.gov/cgi/doc-gw.pl?DocID=44452">http://rules.jpl.nasa.gov/cgi/doc-gw.pl?DocID=44452</a>
Project Manager, JPL Mission Assurance POC, IV&V Facility	2.8 Negotiate a Memorandum of Agreement (MOA) defining the tasks and associated cost and schedule for the NASA IV&V Facility to perform a Criticality Analysis and Risk Assessment (CARA) analysis defining a Critical Functions List (CFL), 3 months prior to subsystem software PDR
Project Manager	2.9 Provides IV&V Facility project documentation for CARA, 3 months prior to subsystem software PDR

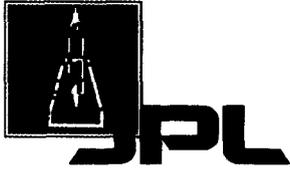


**JPL**

# Establishing a Scope of Work with the NASA IV&V Facility



	<b>Action</b>
<b>IV&amp;V Facility</b>	2.10 Performs CARA analysis and CFL identification 2.11 Delivers CARA technical and cost report
<b>IV&amp;V Facility, GPMC, and NASA</b>	2.12 Negotiate an updated Memorandum of Agreement (MOA) by two months after the subsystem software PDR defining the tasks and associated cost and schedule for the NASA IV&V Facility to perform IV&V services for the negotiated level of IV&V to be applied to the Project. Note: GPMC resolves any negotiation disputes.
<b>IV&amp;V Facility</b>	2.13 Perform the MOA defined tasks 2.14 Report status at project MMRs and QMRs
<b>IV&amp;V Facility</b>	2.15 Provide required support to IV&V activity

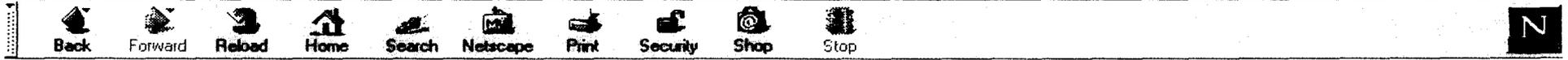


# JPL Software IV&V Website



JPL Software - IV&V - Introduction - Netscape

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## Software Independent Verification & Validation

[INTRODUCTION](#) [WHY IV&V](#) [WHAT TO DO](#) [HOW TO DO IT](#) [WHO HAS DONE IT](#) [FEEDBACK](#) [JPL SOFTWARE HOME](#)

### Introduction

NASA has determined that independent verification and validation (IV&V) of software, when required, will be managed and carried out by the NASA IV&V Facility. The NASA IV&V Facility provides an independent set of services to identify software risks and recommend mitigations. This is applicable to programs and projects subject to NASA Procedures and Guidelines ([NASA NPD 7120.5B](#)) and to other NASA projects/activities containing safety critical software (as defined in [NASA-STD-8719.13A](#)). JPL has set up a supporting process for projects to be in compliance with [NASA NPD 8730.4](#) (Independent Verification and Validation).

#### Why IV&V

- [Frequently Asked Questions](#)
- [NASA NPD 8730.4 \(IV&V\)](#)
- [NASA-STD-8719.13A \(Software Safety\)](#)

#### How To Do It

- [Establishing a Scope of Work with the NASA IV&V Facility \(draft\)](#)
- [Software Independent Verification and Validation \(IV&V\) / Independent Assessment \(IA\) Criteria](#)

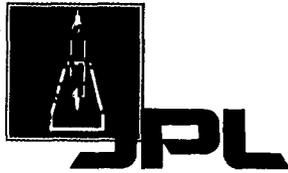
#### What To Do

- [Flight Project Practice, Section 7.4, Independent Verification and Validation](#)

#### Who Has Done It

- [JPL Project, IV&V Criteria Self-Assessment, and MOA Status](#)

Document: Done



# JPL Software IV&V Website



JPL Software - IV&V - Why IV&V - Netscape

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## Software Independent Verification & Validation

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### Why IV&V

[Frequently Asked Questions](#)  
There are a number of recurring issues that arise regarding background, requirements, applicability, etc. relative to software IV&V. These FAQs address those most frequently asked questions to give you some context, background and guidance as to your responsibilities.

[NASA NPD 8730.4 \(IV&V\)](#)  
This is the governing NASA NPD, Software Independent Verification and Validation (IV&V) Policy, and provides the requirements for the policy.

[NASA-STD-8719.13A \(Software Safety\)](#)  
This is one of the key applicable NASA documents cited in the IV&V NPD and provides specifics on software safety issues.

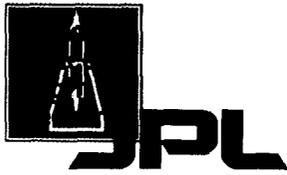
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For comments and suggestions on IV&V, please send email to [Burton Sigal](#), Manager, Software Assurance and IV&V, X 4-1234.  
This page last updated: July 15, 2002.

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# JPL Software IV&V Website



JPL Software - IV&V - Frequently Asked Questions - Netscape

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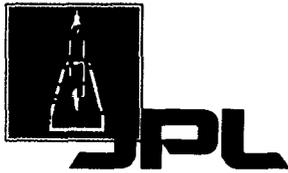
## Software Independent Verification & Validation

INTRODUCTION WHY IV&V WHAT TO DO HOW TO DO IT WHO HAS DONE IT FEEDBACK JPL SOFTWARE HOME

### Frequently Asked Questions

1. What is IV&V?
  - a. A set of risk mitigation verification and validation activities performed by the NASA IV&V Facility
2. Does IV&V replace project V&V and/or SQA activities?
  - a. No, the project is expected to develop a balanced approach to risk mitigation. Project V&V, SQA, and the NASA IV&V Facility are possible providers of risk mitigation.
3. When does IV&V begin?
  - a. The first interface with the NASA IV&V Facility generally happens at AO or proposal response, or after award for directed projects. The JPL Mission Assurance Office provides the [JPL Point Of Contact \("POC"\)](#) with the NASA IV&V Facility.
4. What is the process to become involved with the IV&V Facility?
  - a. Every AO/proposal response team and directed project is required to fill out an initial self assessment using a set of IV&V criteria and submit the data through the [JPL POC](#). It is from this assessment that the determination of IA or IV&V need is initially made.
5. How involved is the IV&V self-assessment?

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# JPL Software IV&V Website



JPL Software - IV&V - What To Do - Netscape

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## Software Independent Verification & Validation

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### What To Do

The Software Independent Verification and Validation (IV&V) / Independent Assessment (IA) Criteria, provides some procedural and guidance support for engaging the NASA IV&V process as required by NPD 8730.4 and JPL requirements of Section 7.4 of the Flight Project Practices.

The template contains the detailed description of the Software Independent Verification and Validation (IV&V) / Independent Assessment (IA) Criteria for the "self-assessment" required in Section 7.4 of the Flight Project Practices. Its purpose is to provide quantifiable criteria for determining whether the project is a candidate for IV&V or IA activities for its software development.

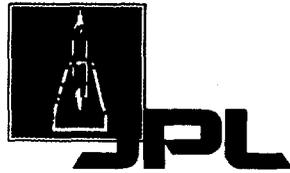
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For comments and suggestions on IV&V, please send email to [Burton Sigal](#), Manager, Software Assurance and IV&V, X 4-1234.  
This page last updated: March 28, 2003.

*NASA STD 8719.13A and NASA NPD 8730.4 have NOT been accepted contractually by Caltech for inclusion in the prime contract with NASA. They are to be used at JPL, where relevant, for general information and guidance purposes only.*



# JPL Software IV&V Website



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## Software Independent Verification & Validation

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### How To Do It

In order to be in compliance with the NASA policy and guidelines and JPL requirements, a procedure has been written to provide explanation and guidance for projects on how they can accomplish what is required of them in the most cost effective and non-invasive way over the life-cycle of the project from AO response to end of Mission Operations. The first key step is for the project to do the IV&V criteria self-assessment, the details and background for which are described in [Software Independent Verification and Validation \(IV&V\) / Independent Assessment \(IA\) Criteria](#).

[Establishing a Scope of Work with the NASA IV&V Facility \(draft\)](#)  
A step by step guide for compliance with the agency IV&V requirements.

[Software Independent Verification and Validation \(IV&V\) / Independent Assessment \(IA\) Criteria](#)  
Everything you ever wanted to know about the NASA IV&V software self-assessment criteria.

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This page last updated: October 18, 2002.

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<http://sqi/ivv/how/how.html>



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## JPL PROJECTS - MARCH 27, 2003

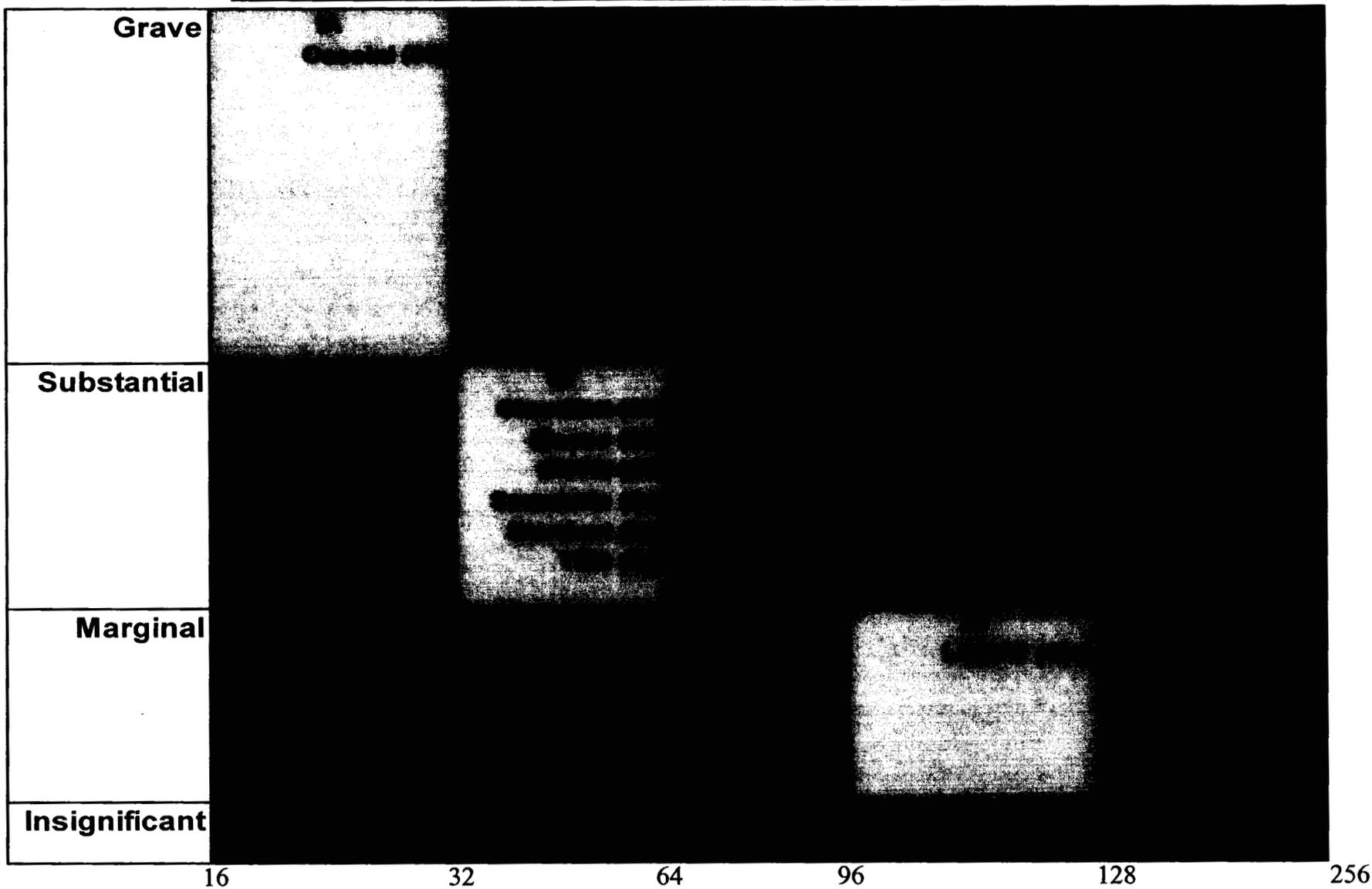
Project	URL	Load	Consequence	Risk	Phase	MOA
ABE	Yes	Yes	Substantial	82	Not Selected	N/A
ACTUATED HYBRID MIRROR	N/A	N/A	N/A	N/A	Tech Demo	N/A
ACRIMSAT	Yes	Yes	Marginal	48	Operations	N/A
AIRS	N/A	N/A	Marginal	34	Operations	N/A
Aquarius	Yes	Yes	Grave	93	Selected (ESSP)	N/A
ASTER	N/A	N/A	N/A	N/A	Operations	N/A
CASSINI	Yes	Yes	Grave	30	Operations	N/A
CLOUDSAT	Yes	Yes	Substantial	40	Implementation	N/A
CNES 07 Orbiter	N/A	N/A	N/A	N/A	Cancelled	N/A
DAWN	Yes	Yes	Substantial	104	Formulation	In Work
DEEP IMPACT	Yes	Yes	Grave	119	Implementation	Yes
DEEP SPACE ONE	Yes	Yes	Substantial	16	Mission Complete	N/A
ECHO	Yes	Yes	Substantial	90	Not Selected	N/A
Europa (X-2000) (Not flight system)	Yes	Yes	Grave	232	Implementation	N/A
GALEX	Yes	Yes	Substantial	32	Implementation	Yes
GALILEO	N/A	N/A	N/A	N/A	Operations	N/A
GENESIS	Yes	Yes	Grave	60	Operations	Yes
G-Marconi Orbiter	N/A	N/A	N/A	N/A	Cancelled	N/A

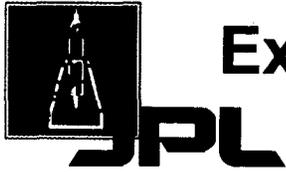


# JPL Project Self-assessment Matrix



## JPL

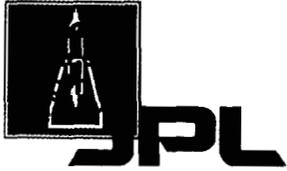




# Example: March 6, 2003 Action Item Status



No.	Project/Center	Assignee	ECD	Action Item	Status	Comment
1	NASA IV&V Facility/JPL	N Keeler/B Sigal	May 02	Provide an explanation of how JPL project specific activities (e.g., V&V, SQA, etc.) are accounted for in the risk identification, mitigation and cost recommendation process	JPL – SQA Software Risk Assessment submitted with project documentation IV&V Facility – responded	Closed 5/10 QMR Closed Mar QMR
2	NASA IV&V Facility	N Keeler	May 02	Define what the IV&V Facility used as a baseline in development of the CARA process (method used to measure risk)	Complete	Closed 5/10 QMR
3	NASA IV&V Facility	N Keeler	May 02	Provide the criteria used in the determination of the Critical Functions List	Complete	Closed 5/10 QMR
4	NASA IV&V Facility	N Keeler	May 02	Initiate monthly, Project MMR, reporting of the NASA IV&V Facility Findings	Complete	Closed 5/10 QMR
5	NASA IV&V Facility	N Keeler	May 02	Provide project specific information relative to deliverables, scheduled tasks and status, action items, project responses, staffing and costs at future Project MMRs and Quarterly reviews	Complete for MER, Deep Impact, SIRTf	Closed 5/10 QMR
6A	MRO	F Huy	May 02	Provide Genesis and Odyssey JPL/LMA NASA IV&V findings to Burt Sigal	Complete	Closed 5/10 QMR
6B	MRO	B Sigal	May 02	Distribute and coordinate Genesis and Odyssey JPL/LMA NASA IV&V findings with Tom Fouser	Distribution complete, info being reviewed	Closed 5/10 QMR



## Summary



- Appoint a single point of contact for IV&V
  - Consistency, experience, guidance
- Develop institutionalized (center-specific) documentation
- Engage senior management early for active advocacy / support
- Brief stakeholders regularly
- Develop, use and update lessons learned
- Focus on value-added activities
  - Software risk management...
- Provide support/shepharding
- Build and maintain relationships
  - Projects
  - IV&V Facility