Ames Procedural Requirements

COMPLIANCE IS MANDATORY

Subject: Ames Software Engineering Requirements

Responsible Office: Code D, Office of the Chief Engineer, Ext. 4-2105, Mail Stop 241-20

DOCUMENT CHANGE LOG

Status [Baseline /Revision /Cancelled]	Document Revision	Date of Change	Description
Baseline	0	5/26/2009	Initial
Revision	1	10/29/2009	Changing document ownership and adding Document History Log Delete reference to the ATAAC and replace with ACE
Revision	2	3/1/2011	Align with NPR 7150.2A and address 2009 Ames OCE Ames Survey finding (Class E1)
Interim Directive	3	5/27/2016	Direct focus on NPR 7150.2B until new revision of APR7150.2 available for release
Revision	4	3/13/2018	This directive formalizes the Interim Policy Statement structure of establishing the Ames processes for compliance and consistency to the B revision of NPR 7150.2.

TABLE OF CONTENTS

PREFACE

Preface

P.1 PURPOSE

This Ames Policy Directive (APR) provides direction for compliance to the NPR 7150.2B, defining Ames specific responsibilities.

P.2 APPLICABILITY

a. This directive applies to all Ames employees, Ames contractors and grantees as specified in their contracts or grants; and to other organizations (i.e., commercial partners, other Federal agencies, international parties, and Ames tenants) as specified and described in written operating agreements.

All ARC Programs and Projects shall follow NPR 7150.2B, to document the practices and procedures to be used in all matters relating to software acquisition, development, assurance, maintenance, operations, and management, effective as of the approval date of this directive.

ARC software activities with prior approval, by the Ames Chief Engineer, for compliance of practices and procedures of previous versions of NPR 7150.2 and/or APR 7150.2 may continue under those agreed upon terms.

For those software activities, wherein Ames is responsible for a task within a project whose governance resides outside of ARC, the task manager shall ensure that applicable NPR 7150.2B requirements are delineated in the task statement of work or task customer agreement.

b. In this directive, all mandatory actions (i.e., requirements) are denoted by statements containing the term "shall." The terms: "may" or "can" denote discretionary privilege or permission, "should" denotes a good practice and is recommended, but not required, "will" denotes expected outcome, and "are/is" denotes descriptive material.
c. In this directive, all document citations are assumed to be the latest version unless otherwise noted.

P.3 AUTHORITY

NPR 7150.2B NASA Software Engineering Requirements

P.4 APPLICABLE DOCUMENTS AND FORMS

a. NPD 7120.4 NASA Engineering and Program/Project Management Policy
b. NPR 7120.5 NASA Program and Project Management Processes and Requirements
c. NPR 7120.7 NASA Information Technology and Institutional Infrastructure Program and Project Management Requirements
d. NPR 7120.8 NASA Research and Technology Program and Project Management Requirements
e. NPR 7150.2B NASA Software Engineering Requirements

f.   NPR 2210.1 Release of NASA Software

g.   NPR 2830.1 NASA Enterprise Architecture Procedures

h.   NASA-STD-8739.8 NASA Software Assurance Standard

i.   NASA-STD-8719.13 NASA Software Safety Standard

j.   APR 1150.2 Ames Engineering Technical Authority

k.   APR 7120.5 Program and Project Management for Space Flight Systems

l.   APR 7120.7 Program/Project Cost Estimating for Space Flight Systems

m.   APR 7120.8 Program/Project Reviews for Space Flight Systems

n.   APR 8040.1 Configuration Management

P.5   MEASUREMENT/VERIFICATION

a.   Verification of compliance is measured through the internal audit process and management review and those results. Measuring effectiveness will at a minimum use customer satisfaction data.

P.6   CANCELLATION

a.   Ames Interim Policy Statement: IPS 7150.2, dated May 28, 2015

/S/

Eugene Tu
Director

DISTRIBUTION STATEMENT:

No restrictions

CHAPTER 1   RESPONSIBILITIES

1.1 Ames Chief Engineer (ACE)

Specific duties include:

a. Determine the applicability of NPR 7150.2 to projects initiated prior to September 27, 2004, the date of the initial approval of NPR 7150.2.

b. Serve as the Technical Authority for Class A, B, C, D, E and safety-critical software projects.

c. Checking the accuracy of the project's classification of software components against the definitions in NPR 7150.2B, Appendix D.

d. Approve software engineering NPR 7150.2B classifications.

e. Review reports and issues from LDEs and PSEs concerning software-related risks, non-conformances, problems, anomalies, etc. to assess the technical risk posture of Ames software project/programs.

f. Approve requirement tailoring to NPR 7150.2B for requirements delegated to the Center Director.

g. Forward and track other technical waivers to NPR 7150.2 which may require other Technical Authority approval.

h. Ensuring that approved compliance matrices, including any waivers and deviations against NPR 7150.2B, are archived as part of retrievable project records.

i. Perform or review all analyses associated with failures occurring in Ames developed software systems or subsystems.

j. Examine trends across Ames software projects/programs to identify potential changes needed to local standards and/or other engineering requirement documents.

1.2 Chief Information Officer (CIO)

Specific duties include:

a. Serve as the Technical Authority for Class G and H software projects and Class F software projects as designated by NASA OCIO.

b. For those classes of software, assess projects' compliance matrices, tailoring, waivers, and deviations from requirements in NPR 7150.2B by:

(1) Checking the accuracy of the project's classification of software components against the definitions in NPR 7150.2B, Appendix D.

(2) Evaluating the project's compliance matrix for commitments to meet applicable requirements in this directive, consistent with software classification.

(3) Confirming that requirements marked "Not-Applicable" in the project's compliance matrix are not relevant or not capable of being applied.

(4) Determining whether the project's risks, mitigations, and related requests for relief from requirements designated with "X" in NPR 7150.2B, Appendix C are reasonable and acceptable.

(5) Coordinating with the ARC S&MA organization that the compliance matrix implementation approach does not impact safety and mission assurance on the project.

(6) Approving/disapproving requests for relief from requirements designated with "X" in NPR 7150.2B, Appendix C, which fall under this Technical Authority's scope of responsibility.

(7)   Facilitating the processing of projects' tailoring/compliance matrices, tailoring, waivers, or deviations from requirements in this directive, which fall under the responsibilities of a different Technical Authority (see column titled "Technical Authority" in NPR 7150.2B, Appendix C).

(8)   Ensuring that approved compliance matrices, including any waivers and deviations against NPR 7150.2B, are archived as part of retrievable project records.

(9)   Reviewing Agency EA alignment per NPR 2830.1, of project IT investments, in coordination with Project and Program managers.

c.   Indicate approval by signature(s) in the compliance matrix itself, when the compliance matrix is used to waive/deviate from applicable "X" requirement(s).

d.   Maintain a reliable list of their Center's projects containing Class G and H software including:

(1)   Project name and Work Breakdown Structure (WBS) number.

(2)   Software name(s) and WBS number(s).

(3)   Software size estimate (report in Kilo/Thousand Source Lines of Code (KSLOCs)).

(4)   Phase of development or operations.

(5)   Software Class or list of the software classes being developed on the project.

(6)   The primary programing languages used.

(7)   Primary life-cycle methodology being used on the software project.

(8)   Name of responsible software assurance organization(s).

(9)   Planned and actual effort and cost.

(10)   Planned and actual schedule dates for major milestones.

1.3 Ames Safety and Mission Assurance (S&MA) Director

Specific duties include:

a.   Perform independent software classification and software safety classification assessments.

b.   Review project Software Assurance and Software Safety plans.

c.   Approve requirement tailoring to NASA-STD-8739.8, Software Assurance Standard, for requirements delegated to the Center S&MA Organization.

d.   Approve requirement tailoring to NASA-STD-8719.13, Software Safety Standard, for requirements delegated to the Center S&MA Organization.

e.   Ensure compliance with NASA-STD-8739.8, Software Assurance Standard.

f.   Ensure compliance with NASA-STD-8719.13, Software Safety Standard.

g.   Review software assurance reports and issues from LDEs and PSEs concerning software-related risks, non-conformances, problems, anomalies, etc. to assess the technical risk posture of Ames software project/programs as needed.

1.4 Project Manager

In this document, the phrase "Project Manager" means the roles and responsibilities of the project manager may be further delegated within the organization to the scope and scale of the system.

Specific duties include:

a.   Ensure activity status update is recorded and approved within Ames software inventory management system prior to and as an entrance criteria to each milestone review. Where milestone reviews are not applicable, the project manager is to provide updates into the software inventory management system during each call for data updates.

b.   As appropriate, recommend software engineering NPR 7150.2B classification and software safety NASA-STD-8719.13 classification for Project software. Ensure that a current NPR 7150.2B Compliance Matrix is maintained and that an electronic copy of the current NPR 7150.2B Compliance Matrix is provided to the Ames Software Lead Discipline Engineer.

c.   Ensure that a current NASA-STD-8739.8 Compliance Matrix is maintained and that an electronic copy of the current matrix is provided to the Ames S&MA Directorate upon request.

d.   For software deemed safety-critical, ensure that a current NASA-STD-8719.13 Compliance Matrix is maintained and that an electronic copy of the current matrix is provided to the Ames S&MA Directorate upon request.

e.   Negotiate the Customer Agreement with the customer, and obtain concurrence from relevant line and program/project management.

f.   Develop and implement the management tools needed to track the cost and schedule of the software task.

g.   Track progress with respect to meeting requirements.

h.   Conduct reviews to apprise the customer and management as to the status of the project and any issues.

i.   Develop and perform the integrated system test to demonstrate functionality and compliance to the customer, including training the customer's workforce if applicable.

j.   Provide the customer with a full set of documentation including as-built drawings/code, and operations and maintenance manuals, as specified by the customer agreement.

k.   Present to management and the customer, at the earliest possible time, recommended solutions to issues that may cause the cost, schedule, or functionality to be compromised.

l.   Ensure that ARC employees and contractors comply with software management, assurance and safety requirements of the software engineering NPR 7150.2B classification and safety criticality.

m.   Adhere to the documentation requirements as outlined in Chapter 4, and defined by the managing organizations documentation format.

n.   Obtain appropriate data rights for custom developed code that provide, at a minimum, rights for Government-wide reuse and code modification.

o.   Make such custom developed code broadly available across the Government; and

establish requirements for releasing a percentage (currently 20 percent) of custom-developed source code that include obtaining sufficient rights to make custom-developed code releasable to the public as open source software.

p. Become cognizant of the new need to negotiate sufficient data rights for custom developed code under NASA projects.

1.5 Program/Project Systems Engineers (PSEs)

The responsibilities of a PSE are defined in APR 1150.2, Section 6.1. Specifically, as related to this APR, the duties of a PSE include:

a. Report independently at project reviews as to the technical readiness (including software) of the project to proceed.

b. Report periodically on technical status (including software) to ACE.

c. Review requests for waivers from NPR 7150.2B or NPR 7120.5.

d. Develop, maintain and provide an electronic copy of the current NPR 7150.2B Compliance Matrix as delegated by the Project Manager.

e. Upon request by the Ames S&MA Directorate:

(1) Report periodically on software assurance status to Ames S&MA Directorate.

(2) Review requests for waivers from NASA 8739.8 and 8719.13.

(3) Develop, maintain and provide an electronic copy of the current NASA 8739.8 and 8719.13 Compliance Matrices as delegated by the Project Manager.

1.6 Ames Software Lead Discipline Engineer (LDE)

The responsibilities of an LDE are defined in APR 1150.2, Section 1.2. These responsibilities include maintaining an appropriate level of expertise in software, assuring that appropriate, discipline-specific requirements, best practices and standards have been applied; assessing any non-conformance with applicable requirements and documentation; and determining that technical solutions are adequate as requested by the Ames Chief Engineer.

In support of the Ames Chief Engineer's Engineering Technical Authority responsibilities the Ames Software Lead Discipline Engineer will also review and recommend to the Ames Chief Engineer:

a. The software classification for all Ames software.

b. Disposition of requested waivers and variants from requirements in NPR 7150.2B or APR 7150.2.

c. (Center) Tailoring of NPR 7150.2B requirements, as designated in Appendix D of NPR 7150.2B.

d. Maintain records of Ames project compliance matrices, waivers, and deviations against NPR 7150.2B

1.7 Line Management (Directorate, Division, and Branch Management

Specific duties include:

Recommend Software Program/Project/Task Managers for Concurrence, as appropriate:

a.   If a Program is assigned to their organization, recommend a Program Manager for concurrence by the Ames Center Director and then the cognizant Associate Administrator.

b.   If a Project is assigned to their organization, recommend a Project Manager for concurrence by the Ames Center Director and then the Program Manager.

c.   If a Software Task is assigned/negotiated by their organization, recommend a Software Task Manager for concurrence by the Project Manager, or other funding source Manager.

For Software Programs, Projects, or Task assigned to their Organization:

a.   Review and concur on Software Program, Project, Task, Customer Agreement or other documents (as appropriate) committing their organization to provide services or products. Specifically, relevant to NPR 7150.2B, review software activity and software assurance technical approach, milestones, deliverable(s), risks, and costs, and concur that their organization can reasonably meet the specified milestones and deliverables within the specified schedule and cost, at the defined risk levels.

b.   Assign Civil Servant staffing, and/or oversee acquisition of appropriate non-Civil Servant services.

c.   Provide infrastructure required to complete the assigned software project. Infrastructure includes, and is not limited to:

(1)   Provide the definition for documentation format, to provide consistency between like activities, and alleviate the need for each new activity to have to design documentation format

(2)   Workspace

(3)   Computers

(4)   IT support

(5)   Tools

(6)   Processes that comply with NPR 7150.2B

(7)   Process assets that comply with NPR 7150.2B (i.e. project templates, examples, and support tools, etc.)

Support the Ames Chief Engineer in the Center's implementation of Technical Authority as applied to software activities:

a.   Conduct periodic supervisory reviews of software activities, assessing overall progress, scope and technical and programmatic risks.

b.   Conduct periodic peer reviews of software activities performed in their organization with a focus on ensuring compatibility with customer requirements, maintaining excellence in technical approach, ensuring compliance with NASA and Ames processes and standards, and the availability of appropriate staffing and infrastructure.

c.   Support Ames Chief Engineer requests for information and respond to actions items/findings.

d.   Raise non-compliance, waiver request, and dissenting opinion to the Ames Chief Engineer.

Support the Ames SM&A Directorate as applied to software assurance activities:

a.   Conduct periodic supervisory reviews of software assurance and software safety activities, assessing overall progress, scope and technical and programmatic risks.

b.   Conduct periodic peer reviews of software assurance activities performed in their organization with a focus on maintaining excellence in technical approach and independence, ensuring compliance with NASA and Ames processes and standards, and the availability of appropriate staffing and infrastructure.

c.   Support Ames SM&A Directorate requests for information and respond to software assurance actions items/findings.

d.   Raise non-compliances, waiver requests, and dissenting opinions regarding NASA STD 8739.8 and 8719.13 to the Ames S&MA Directorate.

CHAPTER 2 SOFTWARE ENGINEERING CLASSIFICATION PROCESS

All ARC projects for which software is an element, whether a stand-alone activity or in support of a broader project, using either acquired software or in-house developed software, shall be given a software engineering NPR 7150.2B classification as defined in NPR 7150.2B Appendix D. In addition, the software shall be given a NASA-STD-8719.13 software safety classification. This software engineering and software safety classification evaluation shall be made during the early or mission definition phase of the project; so that the project planning and/or the software acquisition activities may be put in place to meet the appropriate software engineering NPR7150.2B requirements.

The project manager shall make these classification evaluations in concert with the customer, and document the results of these determinations in the project plan, software development plan, software management plan or other appropriate project documentation. If the software is being developed within a software task, the software task manager may also perform these duties.

SOFTWARE ENGINEERING NPR 7150.2B CLASSIFICATION REVIEW
After the project has evaluated the NPR 7150.2B classification of its software, a software classification review will be conducted. The Ames S&MA Directorate will conduct an independent assessment of the NPR 7150.2B classification. For those classifications ranging from Class A-E, the Ames Chief Engineer's Office will review the NPR 7150.2B classification recommended by the project and the Ames S&MA Directorate. For those classifications ranging from Class F-H, the Ames Chief Information Officer will review the NPR 7150.2B classification recommended by the project and the Ames S&MA Directorate.

If there is a disagreement between the project, the Ames S&MA Directorate, the Chief Engineer's Office, and/or the Chief Information Officer regarding the NPR 7150.2B classification the Chief Engineer's Office will collect additional information and attempt to negotiate a mutual agreement. If a mutual agreement cannot be arrived at, the Ames Chief Engineer will determine the final NPR 7150.2B classification.

SOFTWARE SAFETY NASA STD 8719.13 CLASSIFICATION REVIEW
After the project has evaluated the NASA STD 8719.13 safety classification of its software, a software safety classification review will be conducted. The Ames S&MA Directorate will conduct an independent assessment of the NASA STD 8719.13 safety classification. For those classifications ranging from Class A-E, the Ames S&MA Directorate will review the NASA STD 8719.13 safety classification recommended by the project.

If there is a disagreement between the project and the Ames S&MA Directorate regarding the NASA STD 8719.13 safety classification, the S&MA Directorate will collect additional information and attempt to negotiate a mutual agreement. If a mutual agreement cannot be arrived at, the Ames S&MA Directorate will determine the final NASA STD 8719.13 safety classification.

CHAPTER 3   SOFTWARE ENGINEERING REQUIREMENTS NPR 7150.2B COMPLIANCE MATRIX

All applicable software activities shall comply with NPR 7150.2B. Electronic access to the required method of compliance matrix tracking is available by clicking here or directing your browser to http://go.usa.gov/3fmqp, and is to be used to develop and maintain the NPR 7150.2B requirements. A unique compliance matrix is available for each software classification.

CHAPTER 4   DOCUMENTATION REQUIREMENTS

Documentation Content: The documentation content is outlined within each of the NPR 7150.2B SWE's where activities are described as requiring "tracking", "recording", "documenting", or other related capture of relevant project information.

Documentation Format: Organizations at the Division level containing software management duties shall define the content format for documentation of said software projects.

Projects are to adhere to the documentation format as established by the managing organization's definition.

Documentation Submittal: Software project documentation submittal is to occur in synchronization with reviews, based on the product maturity matrix below. Organizations at the Division level, or lower, may require their projects to submit and report at higher frequency for the purpose of tracking and evaluating the health of those activities. The center Software LDE will evaluate the software documentation, and is responsible for approvals of deviations.

MATURITY OF LIFE CYCLE PRODUCTS AT MILESTONE REVIEWS										
Software Lifecycle Products	MCR	SRR	MDR	SDR	PDR	CDR	SIR	TRR	SAR	ORR
Software Development Plan (SDP) / Software Management Plan (SMP)		P	P		B	U				
Software Schedule	D	P	U	U	B	U				
Software Cost Estimate	D	P	U	U	B	U				
Software Configuration Management Plan (SCMP)		P	P		B	U				
Software Test Plans					P	B	U	U		
Software Test Procedures						P		B		
Software Test Reports									F	
Software Maintenance Plan	D	P	P	U	U	U				
Software Assurance Plan(s)		P	P	P	B	U				
Software Safety Plan, if safety-critical s/w		P			B	U				
Software Requirements Specification (SRS)		P			B	U		U		
Requirements on OTS s/w		P			B	U				
Software Data Dictionary					P	B				
Software Design Description (Architectual Design)					B	U		U		
Software Design Description (Detailed Design)					P	B		U		
Interface Design Description					P	B		U		
Software User's Manual (SUM)										B
Records of Continuous Risk Management	P	U	U	U	U	U			U	
Measurement Analysis Results					X	X				
Operational Concepts (part of "Mission Operations Concept" or separate)		P	U		B	U				
Record of trade-off criteria & assessment (make / buy decision)					X	X				
Acceptance Criteria and Conditions					P	B				

Maturity Types Key
F = Final, D = Draft, P = Preliminary, B = Baseline, U = Updated/Updated as required, X = assume complete (final), not explicit in NPRs

Review Types Key
MCR = Mission Concept Review, **SRR** = System Requirements Review, **MDR** = Mission Definition Review, **SDR** = System Definition Review, **PDR** = Preliminary Design Review, **CDR** = Critical Design Review, **SIR** = System Integration Review, **TRR** = Test Readiness Review, **SAR** = System Acceptance Review, **ORR** = Operational Readiness Review

APPENDIX A.   DEFINITIONS

Customer. Any organization or individual that enters into an agreement for services and/or products.

Customer Agreement. A document binding the supplier to provide to the customer a service and/or product. It typically contains a high-level schedule of milestones and deliverables, major dependencies, a budget, and identifies the primary customer and supplier points of contact.

Design. Process of translating user or customer requirements into a set of instructions or drawings that can be turned into a final product.

Development. The process of turning a design into a final product.

Integration. The process of combining all the components into a fully functional system meeting the customer's requirements.

Lead Discipline Engineer (LDE). The LDE is a senior technical engineer in a specific discipline at the Center that is responsible for determining that technical solutions are adequate. See APR 1150.2, Section 1.2 for responsibilities.
Product. An item that performs the function it was designed for.

Product. An item that performs the function it was designed for.

Program/Project Systems Engineer (PSE). System Engineer working with a specific Program/Project that periodically reports to the Ames Chief Engineer. See APR 1150.2, Section 1.2 for responsibilities.

Safety. Freedom from those conditions that can cause death, injury, occupational illness, damage to or loss of equipment or property, or damage to the environment. Definition is from the NASA Safety Manual, NPR 8715.3.

Safety Critical. Term describing any condition, event, operation, process, equipment, or system that could cause or lead to severe injury, major damage, or mission failure if performed or built improperly, or allowed to remain uncorrected. Definition is from the NASA Safety Manual, NPR 8715.3.

Safety-Critical Software. See description in NASA-STD-8719.13.

Software. See description in NPR 7150.2.

Software Task. A specific software investment identified in a Project Plan having defined requirements, a life-cycle cost, a beginning, and an end. Some software tasks may be identified in both a Project Plan and a Customer Agreement. If a Software Task is not defined in a Project Plan, it must be documented in a Customer Agreement.

Supplier. Entity that creates, maintains, and/or operates the software work products and/or services.

APPENDIX B. ACRONYMS

ACE	Ames Chief Engineer
CDR	Critical Design Review
CIO	Chief Information Officer
IT	Information Technology
KSLOC	Kilo/Thousand Source Lines of Code
LDE	Lead Discipline Engineer
MCR	Mission Concept Review
MDR	Mission Definition Review
NASA	National Aeronautics and Space Administration
NPD	NASA Policy Directive
NPR	NASA Procedural Requirements
OCE	Office of the Chief Engineer
ORR	Operational Readiness Review
OSMA	Office of Safety and Mission Assurance
OSS	Open Source Software
OTS	Off The Shelf
PDR	Preliminary Design Review
PSE	Program/Project Systems Engineer
S/W	Software
SAR	System Acceptance Review
SCMP	Software Configuration Management Plan
SDP	Software Development Plan
SDR	System Definition Review
SIR	System Integration Review
SMA	Safety and Mission Assurance
SMP	Software Management Plan
SRR	Software Requirements Review
SRS	Software Requirements Specification
SUM	Software User's Manual
SWE	Software Engineering
TRR	Test Readiness Review
WBS	Work Breakdown Structure