



**NASA
POLICY
DIRECTIVE**

Directive: NPD 2820.1A
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Responsible Office: D / Office of the Chief Engineer

Subject: NASA Software Policies (Revalidated 5/29/04)

1. POLICY

The following policies cover software created and acquired by or for NASA and also cover Government off-the-shelf (GOTS) software and commercial off-the-shelf (COTS) software when included in a NASA system. These policies shall be applied consistent with sound engineering and risk management practices as determined by cost, size, complexity, life span, risk, and consequences of failure. NASA policy regarding software management, engineering, and assurance is to accomplish the following:

- a. Manage, engineer, and assure software in accordance with common industry standards, processes, and best practices; document the use of standards, processes, and best practices; and tailor standards, processes, and best practices to the development or acquisition.
- b. Implement and integrate software engineering processes and practices with other system development and program/project processes and practices. Develop a plan for acquisition and life-cycle management of the software as part of the program/project plan. This plan should be developed prior to selection of the provider and should address, at a minimum, design tradeoff management, risk management, requirements management, software project planning, project tracking and oversight, software product engineering, subcontract management, configuration management, quality assurance, and peer review.
- c. Develop and maintain a total estimated software life-cycle cost and, where appropriate, perform tradeoff studies which address use of COTS and GOTS software versus created software to satisfy requirements before software is created or acquired.
- d. Demonstrate that the provider of software to be developed has proven organizational capabilities and experience to deliver quality software on time and within budget; require acceptable evidence of the entity's software management, engineering, and assurance standards, processes, and practices to produce quality software. Examples of current acceptable evidence include an independent assessment of a software Capability Maturity Model (CMM) rating of 3 or above. The provider shall develop a plan to manage software throughout the program/project life cycle before the software requirements specification is complete and software design and coding takes place. The plan shall address items required in 1.b.
- e. Document software as to its form and function and verify that such software performs the functions claimed on the platform(s) for which it is

designed without harm to the systems or the data contained therein.

f. Develop risk analyses and management strategies; identify, analyze, plan, track, control, and communicate risks at each stage of the life cycle; document or reference (i.e., their location specified) the results of risk analyses and management strategies in program/project plans; and employ verification and validation techniques for risk mitigation, including Independent Verification and Validation (IV&V), based risk and consequences of failure.

g. Facilitate reuse of NASA-funded software, as well as transfer, consistent with law and applicable agreements, for commercial, industrial, educational, and governmental purposes; and protect NASA-funded or -created software as valuable intellectual property during all phases of the life cycle.

2. APPLICABILITY

This Directive applies to NASA Headquarters and Centers, including Component Facilities, and the Jet Propulsion Laboratory to the extent defined in its contract, for all software acquisitions and developments initiated by NASA after the effective date of this directive.

This Directive applies to software acquisitions and developments initiated by NASA prior to the effective date when determined by either the responsible Program Associate Administrator or the Center Director of the implementing Center.

3. AUTHORITY

a. 42 U.S.C. 2473(c)(1) of the National Aeronautics and Space Act of 1958, as amended.

b. Public Law 104-13, Paperwork Reduction Act of 1995.

c. 40 U.S.C. 1401, et seq. Section 808 of Public Law 104-208, the Clinger-Cohen Act of 1996 [renaming, in pertinent part, the Information Technology Management Reform Act (ITMRA), Division E of Public Law 104-106.

d. OMB Circular A-130, Management of Federal Information Resources.

4. REFERENCES

a. See Attachment 1 for references that apply to the management, engineering, and assurance of NASA software.

b. See Attachment 2 for references that are relevant to the management, engineering, and assurance of NASA software.

5. RESPONSIBILITY

The NASA Chief Information Officer (CIO), the NASA Chief Engineer, and the Associate Administrator for Safety and Mission Assurance (AA-SMA) are responsible for jointly promoting software policies, standards, best practices, and guidance in their areas of responsibility. They shall coordinate efforts to maximize the commonality, clarity, and effectiveness of direction and guidance. Roles and responsibilities for all NASA entities relative to this policy will be carried out within the framework of the Strategic Management Handbook and are not repeated here:

a. The NASA CIO shall promote the cost-effective acquisition, development, and operation of software in support of NASA missions, programs, and institutions. This shall be accomplished in conjunction with the Office of Safety and Mission Assurance, the Office of the Chief Engineer, and the Enterprise offices.

b. The NASA Chief Engineer shall integrate NASA software management, engineering, and assurance policies, standards, best practices, and guidance into directives applicable to NASA's systems engineering and

program management processes. The NASA Chief Engineer and the Engineering Management Board (EMB) shall charter a Software Working Group (SWG) to advise the Agency on software-related matters and recommend software management, engineering, and assurance policies, standards, best practices, and guidance.

c. The AA-SMA shall assure the safety, quality, and reliability of NASA software; review project software processes and make recommendations to the governing Program Management Council (PMC); conduct oversight of NASA's software assurance programs; and conduct Process Verification Reviews of programs/projects to ensure compliance with this Directive and independently assess project software management, engineering, and assurance practices. The AA-SMA shall appoint and support representatives to the SWG.

d. The Associate Administrator for Safety and Mission Assurance shall, through its Functional Office role, sponsor the NASA Software IV&V Facility in West Virginia under the management and oversight of the Goddard Space Flight Center. This facility shall support NASA's program for improving software assurance, including conducting IV&V and other trusted verifications.

e. Enterprise Associate Administrators and Center Directors shall appoint and support representatives to the SWG.

f. The governing PMC shall review program and project software processes and products including, but not limited to evidence of conformance to this policy; use of IV&V and other trusted verifications (e.g., independent assessments and peer reviews); and other risk mitigation processes as appropriate based on program/project cost, size, complexity, life span, risk, and consequences of failure.

7. MEASUREMENTS

a. The following shall be evaluated for compliance with this Directive:

(1) Evidence of project conformance to this policy.

(2) Agency trends on the following:

(a) Software cost and schedule baseline deviations; and

(b) Degree to which delivered software satisfies its requirements, including safety, quality, and reliability measures.

(3) Results of the following:

(a) Assessments and audits of conformance to CMM in NASA software creation and acquisition organizations;

(b) Other surveys relating to the implementation of this Directive;

(c) Improvements resulting from the use of the CMM;

(d) Improvements resulting from case studies and shared experiences.

b. Specific responsibilities for collecting, analyzing, and reporting metrics are to be contained in NPR 2820.

6. DELEGATION OF AUTHORITY

None.

/s/ Sean O'Keefe
Administrator

ATTACHMENT A: (TEXT)

ATTACHMENT 1 APPLICABLE REFERENCES

These references apply to the management, engineering, and assurance of NASA software.

- (1) NPD 1280.1, NASA Management Systems
- (2) NPD 2091.1, Inventions Made by Government Employees.
- (3) NPD 2210.1, External Release of NASA Software.
- (4) NPD 2800.1, Managing Information Technology.
- (5) NPD 2810.1, Security of Information Technology.
- (6) NPD 7120.4, Program/Project Management.
- (7) NPD 8700.1, NASA Policy for Safety and Mission Success.
- (8) NPR 2210.1, External Release of NASA Software.
- (9) NPR 2800.1, Managing Information Technology.
- (10) NPR 2810.1, Security of Information Technology.
- (11) NPR 7120.5, NASA Program and Project Management Processes and Requirements.
- (12) NPD 8730.4, Software Independent Verification and Validation (IV&V) Policy.
- (13) NASA-STD-8719.13, NASA Software Safety Technical Standard.
- (14) NASA-STD-2202-93, NASA Software Formal Inspection Process Standard.
- (15) ISO 9000-3, Quality Management and Quality Assurance - Part 3 Guidelines for the Application of ISO 9001: 1994 to the Design, Development, Supply, Installation, and Maintenance of Computer Software.
- (16) Carnegie Mellon University/Software Engineering Institute, Continuous Risk Management Guidebook, 1996.
- (17) OMB Circular No. A-119, Federal Participation in the Development and Use of Voluntary Standards.

ATTACHMENT 2 RELEVANT REFERENCES

These are relevant to the management, engineering, and assurance of NASA software.

- (1) CMU/SEI - 93 - TR - 24, The Capability Maturity Model for Software, Version 1.1, February 1993.
- (2) CMU/SEI - 93 - TR - 25, Key Practices of the Capability Maturity Model, Version 1.1, February 1993.
- (3) CMU/SEI-2002-TR-010, The Software Acquisition Capability Maturity Model (SA-CMM), Version 1.03, March 2002.
- (4) CMU/SEI - 2002 - TR - 011, CMMI for Systems Engineering/Software Engineering/Integrated Product and Process Development/Supplier Sourcing, Version 1.1, Continuous Representation, March 2002.
- (5) CMU/SEI-2002-TR-012 - CMMISM for Systems Engineering/Software Engineering/Integrated Product and Process Development/Supplier Sourcing, Version 1.1, Staged Representation (CMMI-SE/SW/IPPD/SS, V1.1, Staged) March 2002.
- (6) RTCA/DO-178B - 1992 - Software Considerations in Airborne Systems and Equipment Certification, 3/26/1999.

- (7) ISO 9001, ANSI/ASQC Q9001 - 1994, Quality Systems - Model for Quality Systems - Model for Quality Assurance in Design, Development, Production, Installation, and Servicing.
- (8) IEEE/EIA 12207.0-1996 Industry Implementation of International Standard ISO/IEC 12207: 1995 Standard for Information Technology Software -- Life Cycle Processes.
- (9) IEEE/EIA 12207.1-1997 Industry Implementation of International Standard ISO/IEC 12207: 1995 Standard for Information Technology Software -- Software Life Cycle Processes - Life Cycle Data.
- (10) IEEE/EIA 12207.2-1997 Industry Implementation of International Standard ISO/IEC 12207: 1995 Software Life Cycle Processes - Implementation Considerations.
- (11) IEEE 1012-1998 Standard for Software Verification and Validation.
- (12) NASA-GB-A201-89, NASA Software Assurance Guidebook, Sept 1989.
- (13) NASA-GB-1740.13-96, NASA Guidebook for Safety Critical Software - Analysis and Development.
- (14) NASA-GB-001-94 Software Engineering Program- Software Measurement Guidebook, August 1995.
- (15) NASA-GB-001-96 Software Engineering Program- Software Management Guidebook, November 1996.
- (16) NASA/TP-98-208193, Formal Methods Specification and Verification Guidebook for Software and Computer Systems, Volume I: Planning and Technology Insertion, December, 1998.
- (17) NASA-GB-001-97 NASA Formal Methods Specification and Analysis Guidebook for the Verification of Software and Computer Systems, Volume II: A Practitioner's Companion, May 1997.
- (18) ISO 9001-2000, ANSI/ISO/ASQ Q9001-2000, American National Standard - Quality management systems-requirements.

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None.

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