

**MPR 8060.2
REVISION E**

**EFFECTIVE DATE: September 7, 2004
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MARSHALL PROCEDURAL REQUIREMENTS

ED01

NON-FLIGHT AND NON-FACILITY DESIGN AND DEVELOPMENT

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DOCUMENT HISTORY LOG

Status (Baseline/ Revision/ Canceled)	Document Revision	Effective Date	Description
Baseline		3/6/00	
Revision	A	1/24/01	Added the following sentence to paragraph 2.2 (Project Manager Responsibilities): "The Project Manager is also responsible for ensuring that design activities comply with non-flight requirements of MWI 8040.1, paragraph 6e." Modified paragraph 4b to require that provisions be made for signatures or initials to be placed directly on printed forms of design output. For non-printed forms of design output, a 'statement of concurrence' is required as opposed to a 'memo of concurrence'.
Revision	B	6/4/01	Changed 'Control' to 'and Development' in all occurrences of this document's title. Deleted 'control'; changed 'will' to 'shall'; 'Implementation...will' to 'Its...shall' in P.1. Rewrote P.2 (Applicability). Changed 'the...effect.' to 'this...date.' Inserted 'c. input requirements;' in 1.1, changed 'ATPs' to 'An ATP', and relettered the remaining list. Changed 'Designer' to 'Design and Development Personnel' in 1.5 and 2.5. Expanded 'MMDS' acronym in 1.8. Added 'design and development' to 2.4. Changed 'is' to 'are' and 'Designer' to 'D/D Personnel' in 2.5. Changed 'control...output' to 'plan...product'; added 'at the organizational level' in 3. Added 'and submits' and 'to an...activity.' to 3.1.1. Changed 'Provides...activity.' to 'Determines...activities.' in 3.1.2, Deleted 3.1.3. Deleted 3.2. Renumbered 3.2.1 to new 3.1.3. Deleted 'Requester' in Actionee column; changed 'Defines' to 'Manages'; deleted 'organizational...technical'; changed '. These...an OI.' to 'to...responsibility,' and in 3.1.3. Renumbered 3.2.2 to 3.1.4 and replaced 'Ensures...basis.' with 'Updates...progresses.'. Added 3.1.5. Renumbered 3.3 to 3.2, 3.3.1 to 3.2.1, 3.3.4 to 3.2.2, and deleted 3.3.2 and 3.3.3. Added 'and/or D/D Personnel' to Actionee column in 3.2.1 and changed 'Identifies... means.' to 'Determines...activities.'. Deleted 'Requester and/or Designer' from Actionee column in 3.2.2; added 'Reviews...adequacy.'; deleted 'with...requirements'. Added 3.2.3. Renumbered 3.4 to 3.3, 3.4.1 to 3.3.1, 3.4.2 to 3.3.2, deleted 3.4.3. Changed 'Designer' to 'D/D Personnel', 'Documents' to 'Provides'; 'terms...Note:' to 'a form...release.' in 3.3.1. Added 'input' to 3.3.2(a) and changed '3.3' to '3.2' in 3.3.2(a), (b), and (c). Deleted 'and' from 3.3.2(b). Changed 'functioning' to 'use' and '!' to '; and' in 3.3.2(c). Added 3.3.2(d). Renumbered 3.5 to 3.4, 3.5.1 to 3.4.1, 3.5.2 to 3.4.2. Added 'or D/D Personnel' to Actionee column in 3.4.1 and changed 'Plans and' to 'Systematically'; deleted 'documented', and changed 'and includes' to 'to...Includes'. Added 'and...actions' and changed '4b' to '4c' in 3.4.2. Renumbered 3.6 to 3.5, 3.6.1 to 3.5.1, 3.6.2 to 3.5.2. Added 'or D/D Personnel' to Actionee column in 3.5.1 and changed '3.5' to '3.4'; deleted 'In addition... demonstrations.' Changed 'measures' to 'results...actions'; '4b' to '4c' in 3.5.2. Renumbered 3.7 to 3.6, 3.7.1 to 3.6.1, added 3.6.2. Added 'as...3.1.2' and changed 'conforms...use.' to 'is...practicable.' in 3.6.1. Renumbered 3.8 to 3.7, 3.8.1 to 3.7.1, 3.8.2 to 3.7.2, 3.8.3 to 3.7.4. Added 3.7.3. Changed 'the Designer(s)' to 'design...implementation.'; deleted 'requirement' and 'to...organization'; and added 'by...organization' in 3.7.1. Changed 'Designer' to 'D/D Personnel' and added 'verifies,' to 3.7.2. Deleted 'such' and added 'and...actions'; changed '4.b' to '4.c' in 3.7.4. Changed '3.1.5' to '3.1.3' in 4.a. Made 4.c a regular paragraph, relettered 4.b to 4.c then added new 4.b. Deleted three occurrences of 'design', added 'Validation/', 'validation,', and '3.4.2,; changed '3.8.3' to '3.7.4 respectively'; 'will' to 'may'; and 'For' to 'Alternately...for' in 4.c. Added four occurrences of 'and development' in 4.b, three occurrences in

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			1.9; two occurrences in P.2, 1.3, 1.4, 1.5, 2.2, and 3.3.1; and one occurrence in P.1, 1.1, 1.2, 1.6, 1.7, 1.10, 1.12, 3., 3.1.1, 3.1.4, 3.2, 3.3, 3.4, 3.4.1, 3.5, 3.5.1, 3.6, and 3.7. Added 'Design and Development' to figure 1 title and revised flow chart. (Document footer URL updated by the Directives Manager 11/19/2003.)
Revision	C	12/10/2003	Changed "6.e" to "6.1.5" in 2.2. Changed "quality record" to "record" throughout the document.
Revision	D	6/8/2004	Added NPD 8070.6 to P.4 (Applicable Documents). Added MWI 8060.2 to P.5 (References). Removed sentences pertaining to 'output approval' and 'control methods' in 3.3.1 and replaced them with paragraphs 3.3.1.1 and 3.3.1.2.
Revision	E	9/7/2004	In compliance with center-wide action (CAITS # 04-DA01-0387), changed all occurrences of MPG to MPR and reworded document as necessary to differentiate requirement statements from supporting text. Changed 'should establish' to 'establishes' in 1. Changed 'maintained in' to 'a part of' in 1.8. Changed 'procedure' to 'directive' in 2.1. Added 'Configuration .../Projects' to 2.2. Changed 'document' to 'directive' in 2.4 and 2.5. Changed 'screen...ensuring' to 'ensure' in 2.6. Added 'Special...4405' to 3.3.1.2. Changed 'method' to 'methodology' and 'document' to 'directive' in 4.

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PREFACE

P.1 PURPOSE

This Directive defines the minimum requirements and guidelines for non-flight and non-facility design and development at Marshall Space Flight Center (MSFC). Its implementation shall satisfy the requirements of the “Marshall Management Manual” (MMM), MPD 1280.1.

P.2 APPLICABILITY

This Directive shall be applicable to any non-flight and non-facility design and development activity:

- a. That produces hardware or software that directly interfaces with flight hardware for the purpose of testing, manufacturing, processing, handling, etc., of the flight hardware; or
- b. Where failure to ensure the quality of the output or product from that activity could adversely affect a critical mission objective (development or production of a piece of hardware or software, meeting a schedule milestone, etc.); or
- c. When the project manager or an organization's customer requires the use of this procedure or requires the highest level of design and development control for the output or product produced from that activity.

In determining the applicability of this Directive to any activity, sound engineering rationale shall be employed by the design organization in the interpretation of P.2a through P.2c above. As an example, designs for manufacturing or development 'aids' (such as alignment jigs, holding fixtures, electronic signal converters, electronic checkout boxes, etc.) shall be excluded if the affected flight component will subsequently undergo sufficient test or inspection to find any errors introduced or overlooked by that aid.

This Directive may be used as a guideline for other non-flight, non-facility design and development activities. Organizational Issuances should be created for those activities to ensure that appropriate and consistent practices are utilized and appropriate records of those practices are maintained.

This Directive shall be applicable to those activities addressed above performed by MSFC personnel or by MSFC support contractors and commencing on or after this document's effective date.

P.3 AUTHORITY

MPD 1280.1, “Marshall Management Manual”

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P.4 APPLICABLE DOCUMENTS

- a. NPD 8070.6, "Technical Standards"
- b. MPD 1280.1, "Marshall Management Manual"
- c. MPR 1440.2, "MSFC Records Management Program"
- d. MWI 8040.1, "Configuration Management Plan, MSFC Programs/Projects"

P.5 REFERENCES

- a. MPR 8060.1, "Flight Systems Design/Development Control"
- b. MPR 8823.1, "Design Control of Facilities"
- c. MWI 8060.2, "Special Test Equipment (STE) Design Group Support Request (MSFC Form 4405)"

P.6 CANCELLATION

MPG 8060.2D dated June 8, 2004

Original signed by
Robin N. Henderson for

David A. King
Director

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DOCUMENT CONTENT

1. DEFINITIONS

1.1 Authority to Proceed (ATP). An ATP authorizes an organization to perform a design and development activity. An ATP may be in the form of a Collaborative Work Commitment (CWC), Request for Service, memo, transcribed verbal instruction, organization-level form, etc. (or any combination of the aforementioned) and establishes the following:

1.1.1 the requester;

1.1.2 the activity to be performed;

1.1.3 input requirements;

1.1.4 resources (such as a funding source or valid cost code);

1.1.5 the initiation date;

1.1.6 a requested timeframe to perform the activity;

1.1.7 contacts (any personnel or organization(s) whose input is necessary to perform the activity); and

1.1.8 authorization (signature or other means) that allows the organization to commit the necessary MSFC funds and/or resources to perform the design activity.

1.2 Customer. The customer is the end user of the output or product produced by a design and development activity.

1.3 Design and Development Activity. An organized effort by appropriately trained personnel to create design and development output that satisfies (or is used to produce a product that satisfies) a customer's requirements.

1.4 Design and Development Output. The documented, typically interim, results of a design and development activity, such as sketches, drawings, procedures, specifications, analyses, computer programming code (i.e., software), reports, etc.

1.5 Design and Development Personnel. Any person, NASA or contractor, who is tasked with performing a design and development activity. This includes engineers, designers, draftsmen/detailers, software programmers, and anyone else whose work is considered a design and development activity.

1.6 Non-Facility. Any design and development activity not covered by MPR 8823.1, "Design Control of Facilities."

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1.7 Non-Flight. Any design and development activity not covered by MPR 8060.1, “Flight Systems Design/Development Control.”

1.8 Organizational Issuances (OIs). OIs provide detailed instructions for internal use within an organization. OIs may apply to two or more organizations if issued jointly by heads of the organizations involved. OIs are not a part of the Marshall Management Directives System. OIs include, but are not limited to, organizational work instructions (OWIs), processes, procedures, memoranda, and organizational forms. (Refer to MPR 1410.1, “Document and Data Control for Organizational Issuances.”)

1.9 Product. The final output of any design and development activity that satisfies the customer's requirements. In addition to the items defined under Design and Development Output, a product may be hardware that is fabricated, procured, and/or assembled from the information contained in the design and development output.

1.10 Requester. The requester is the person who initiates and monitors the design and development activity.

1.11 Validation. Confirmation by examination and provision of objective evidence that particular requirements for a specific use of a product are fulfilled. Validation is typically applicable only where a product (hardware or software) can be functionally tested prior to use.

1.12 Verification. Confirmation by examination and provision of objective evidence that specified requirements of design and development activity output have been fulfilled.

2. RESPONSIBILITIES

2.1 Director, George C. Marshall Space Flight Center, shall ensure the efficacy of this directive by providing qualified personnel to ensure the implementation and shall ensure the enforcement of this directive on all applicable activities at MSFC.

2.2 Project Manager shall be responsible for the planning, definition, and timely accomplishment of the design and development activity, and shall ensure that the product meets all requirements. The project manager shall also be responsible for ensuring that design and development activities comply with non-flight requirements of MWI 8040.1, paragraph 6.1.5, "Configuration Management Plan, MSFC Programs/Projects".

2.3 Systems Engineer shall be responsible for ensuring the adequacy of requirements and output, ensuring that organizational technical interfaces function as required, and supporting the project manager in determining that the product meets all established requirements. Note: The project manager and systems engineer may be the same person.

2.4 Requester shall be responsible for initiating and/or monitoring the design and development activity and performing the ‘requester’ actions identified in this directive. If the requester is the

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project manager or systems engineer, then the requester shall also have the responsibilities defined in 2.2 and/or 2.3 above.

2.5 Design and Development Personnel shall be responsible for performing the ‘D/D Personnel’ actions identified in this directive.

2.6 Project Manager, Systems Engineer, Requester and Design/Development Personnel shall also be responsible for entering all technical standards relative to the design and development of the hardware on the NASA Standards Update Notification System (<http://standards.nasa.gov>) to ensure that the most current version of the standard is being used.

3. PROCEDURE

The following actions are intended to establish the procedures necessary to plan and control the product of a design and development activity. They are intended to be generic in nature, recognizing the wide variety of activities addressed by this document, and shall require further elaboration at the organizational level in an OI.

<u>Actionee</u>	<u>Action</u>
	3.1 <u>Design and Development Planning</u>
Requester	3.1.1 Shall prepare and submit an ATP for each design and development activity to an organization that is equipped with adequate resources to perform the activity.
	3.1.2 Shall determine design and development stages, the review, verification, and validation appropriate for each stage, and responsibilities and authorities for design and development activities.
	3.1.3 Shall manage the interfaces between different groups which input into the design and development activity to ensure effective communication and clear assignment of responsibility.
	3.1.4 Shall update, as appropriate, any planning output as the design and development activity progresses.
D/D Personnel	3.1.5 Shall maintain the ATP as a record (reference section 4.1).
	3.2 <u>Design and Development Input</u>
Requester and/or D/D	3.2.1 Shall determine functional, performance, applicable statutory and regulatory, and other essential input requirements. Where applicable,

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- Personnel includes information derived from previous similar design and development activities.
- 3.2.2 Shall review input requirements for adequacy and resolve incomplete, ambiguous, or conflicting requirements.
- D/D Personnel 3.2.3 Shall maintain input requirements as records (reference section 4.2). Input requirements shall be documented in the ATP, design and development output (for example, as a general note on a drawing), or by other means.
- 3.3 **Design and Development Output**
- D/D Personnel 3.3.1 Shall provide the output of the design and development activity in a form that enables verification against the design and development input.
- 3.3.1.1 Design and development output shall be approved prior to release, and the methods for controlling and approving this output shall be detailed in an Organizational Issuance (OI) or in a Marshall Work Instruction (MWI); or
- 3.3.1.2 For work performed by the Special Test Equipment Design Group, the control and approval of design and development output shall be detailed in MWI 8060.2, "Special Test Equipment (STE) Design Group Support Request (MSFC Form 4405)".
- 3.3.2 Shall ensure that the output:
- 3.3.2.1 meets all input requirements (as defined in section 3.2);
- 3.3.2.2 contains or makes reference to acceptance criteria for the product (such as dimensional tolerances, required inspections, proof loads, functional tests, etc., identified in section 3.2);
- 3.3.2.3 identifies those characteristics that are crucial to the safe and proper use of the product (including operation, storage, handling, maintenance, and disposal requirements identified in section 3.2); and
- 3.3.2.4 provides appropriate information for purchasing, production, and for service provision.

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3.4 **Design and Development Review**

- Requester or D/D Personnel 3.4.1 Shall systematically conduct reviews of the output at appropriate stages of the design and development activity to evaluate the ability of the output to fulfill requirements and to identify any problems or propose necessary actions. Shall include, in the review process, representatives of all functions concerned with the activity stage being reviewed. As a minimum, a final review of the output at the 100% stage shall be required.
- 3.4.2 Shall maintain records of such reviews and any necessary actions as records (reference section 4.3).

3.5 **Design and Development Verification**

- Requester or D/D Personnel 3.5.1 Shall perform verification at appropriate stages of the design and development activity to ensure that the verification-stage output meets the verification-stage input requirements. As a minimum, a final verification of the output at the 100% stage shall be required. Verification may be satisfied in whole or in part by the design review process (reference section 3.4).
- 3.5.2 Shall maintain records of verification results and any necessary actions as records (reference section 4.3).

3.6 **Design and Development Validation**

- Requester 3.6.1 Shall perform validation as required in 3.1.2 to ensure the product is capable of fulfilling the requirements for the specified or known intended use or application. Shall ensure that validation is completed prior to the delivery or implementation of the product wherever practicable.
- 3.6.2 Shall maintain records of validation results and any necessary actions as records (reference section 4.3).

3.7 **Design and Development Changes**

- Requester 3.7.1 Shall identify any changes and provide the necessary information to design and development personnel. Shall validate (as appropriate) all changes before their implementation. Shall resubmit an ATP if required by the design and development organization.

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- D/D Personnel 3.7.2 Shall document, review, verify, and approve (by authorized personnel) all changes before their implementation.
- 3.7.3 Shall ensure that reviews of changes include evaluation of the effects of the changes on constituent parts and delivered products.
- 3.7.4 Shall maintain records of changes and any necessary actions as records (reference section 4.3).

4. RECORDS

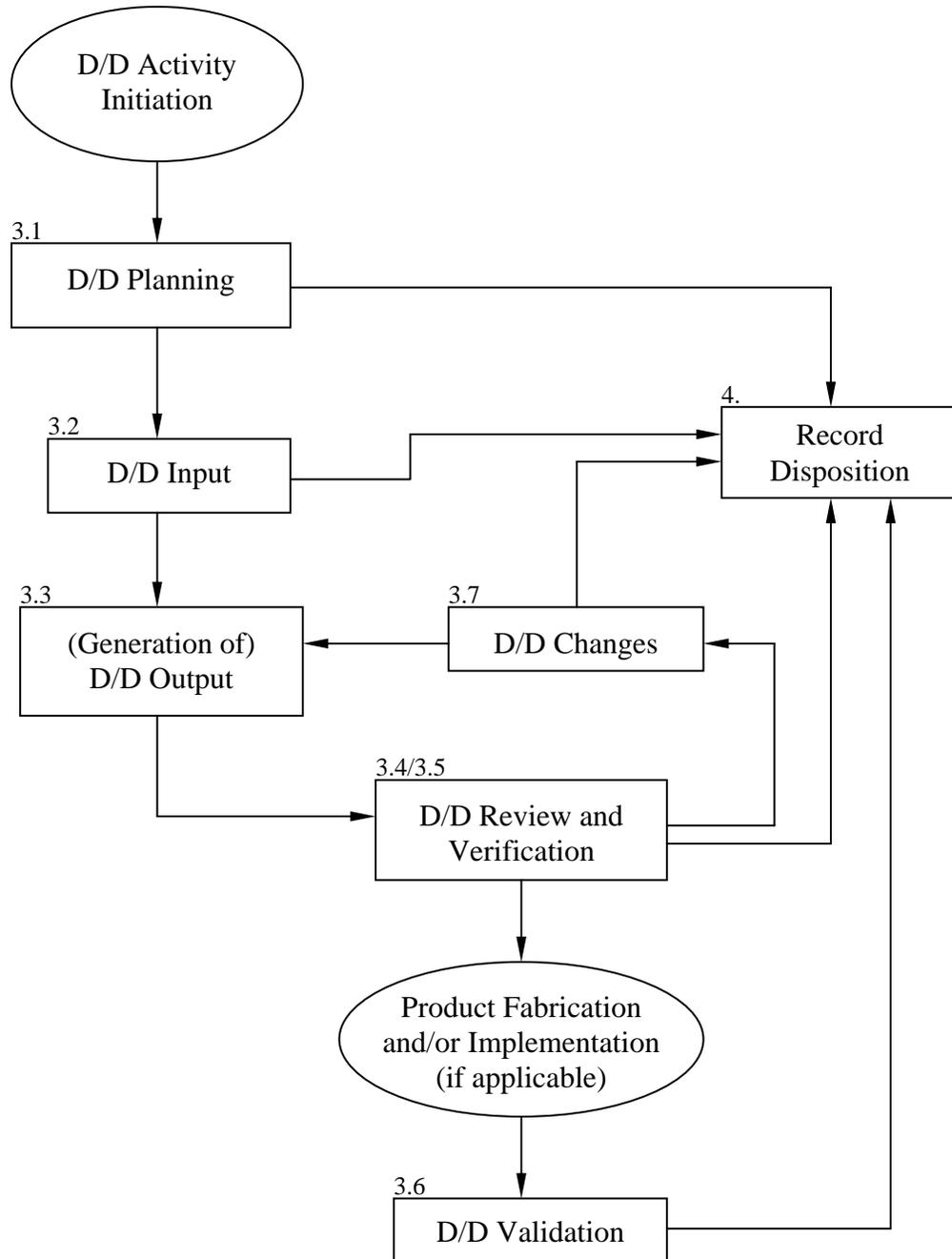
The storage location, methodology, custodian, retention, disposition, etc., of records shall be defined in an OI that satisfies the requirements of MPR 1440.2, "MSFC Records Management Program." As a minimum, the implementation of this directive creates the following records:

- 4.1 ATP - ATPs shall be maintained (reference section 3.1.5).
- 4.2 Input Requirements – Input requirements shall be maintained (reference section 3.2.3).
- 4.3 Design and Development Review/Verification/Validation/Changes - Records documenting design and development review, verification, validation, and changes shall be maintained (reference sections 3.4.2, 3.5.2, 3.6.2, and 3.7.4 respectively). Drawings and other printed forms of design and development output shall provide appropriately labeled locations for signatures and/or initials from the reviewing representative(s) as evidence of review, verification, and changes. Alternately, and for non-printable forms of design and development output such as software, a signed statement of concurrence (that adequately identifies the output and/or revision level) from the reviewing representative(s) shall be evidence of review, verification, and changes. In either case, the original or a photocopy of the original shall be maintained.

5. FLOW DIAGRAM

See Figure 1.

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Design and Development (D/D) Activity Flowchart - Figure 1

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