

Contract No. TBD, Exhibit II
Date: May 24, 2004

**EXHIBIT II:
MARS UHF PROXIMITY ANTENNA (MUPA)
CONTRACT DATA REQUIREMENTS LIST**

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CONTRACT DATA REQUIREMENTS LIST**

REVISION SHEET

| <i>REVISION</i> | <i>DATE</i> | <i>AFFECTED PAGES</i> | <i>NOTES</i> |
|------------------------|--------------------|------------------------------|---------------------|
| N/A | N/A | N/A | N/A |

CONTRACT PLANS AND DOCUMENTATION

The documentation deliverable under the referenced Contract is summarized in the following Contract Data Requirements List (CDRL). This CDRL list identifies the data items to be delivered, when delivery is required, the quantity and type of each item, and frequency of issue. The Data Requirements Description (DRD) forms referenced in the CDRL list provide the specific requirements for the item(s) to be delivered, reference documents, and other instructions as to content, format, and preparation. The referenced DRD forms are also included as part of this Exhibit.

Non-Design Documentation Identification

The Contractor shall display on the cover of the title page of all deliverable non-design documentation (all documents except drawings and specifications), the following minimum information:

- (1) Document Title
- (2) Contractor's Name
- (3) Contract Number
- (4) Document Number (JPL or Contractor assigned)
- (5) DRD Number and CDRL Item Number
- (6) Subsystem or Support Equipment Name
- (7) Approval Signatures – Contractor, for final document, cite JPL approval letter
- (8) Project Identification, Mars Telecom Orbiter (MTO)
- (9) Subsystem or Support Equipment Reference Designation Number (as applicable)
- (10) Date of Issue or Publication
- (11) Revision or Change Identification

Data Approval Requirements

JPL will review documents submitted by the Contractor for JPL approval and will approve or provide comments within ten (10) working days of receipt at JPL, except as otherwise provided for in this Exhibit and the Statement of Work. In the event JPL does not make a formal disposition of a given document within the required ten (10) working days, the document is approved as submitted.

If the draft is approved by JPL, JPL will transmit the signed cover or title page to the Contractor. The Contractor shall then prepare and deliver the final copies as indicated in the CDRL. If the original or draft submittal requires modification before JPL approval will be granted, the following steps will be taken:

- (1) The modifications required by JPL will be sent to the Contractor in writing by the JPL Contract Negotiator and discussed between the parties.
- (2) The Contractor shall submit an updated draft, containing the required modifications within ten (10) working days after receiving written notice of the required modifications.
- (3) If the updated draft is approved by JPL, JPL will transmit the signed cover or title page to the Contractor. The Contractor shall then prepare and deliver final copies as indicated in the CDRL.

Documents that are conditionally approved by JPL shall be resubmitted as final documents if all conditions of approval are exactly met. If it is not possible to exactly meet the conditions of approval, the Contractor shall resubmit the document with all possible corrections completed and a letter explaining why the remaining corrections could not be made. Unless otherwise specified, re-submittal of data for approval shall be so identified and delivered ten (10) working days after receipt of JPL's comments. Revisions or updates to any data requirements set forth herein shall be resubmitted to JPL. Unless otherwise specified in

the CDRL or DRD, the requirements, approvals, and number of required copies of the data items originally submitted shall also be applicable to the revision submittals.

Data Distribution

The number of copies to be delivered to JPL is given in CDRL Block 9. A letter of transmittal shall deliver all data to the JPL Contract Negotiator.

Due Dates

Unless otherwise specified, all time periods given in CDRL Block 8 are in calendar days.

CDRL Definitions

Specific CDRL Block Descriptions are:

- (a) In CDRL Block 6, an “A” designates ‘JPL Approval’ and shall be interpreted as meaning that the approval of JPL is required before the indicated activity or task can proceed (see discussion above).
- (b) In CDRL Block 6, an “X” indicates that JPL will review the document or item in parallel with the activity. The Contractor does not have to obtain JPL approval to proceed with the activity or task.
- (c) In CDRL Block 9, the term “ORIG” is to be interpreted as meaning a reproducible copy. In a few cases, the original might be an electronic copy (e.g., thermal model) which could also be interpreted as MM (see below).
- (d) In CDRL Block 9, the term “MM” is to be interpreted as meaning ‘Magnetic Media’ copy. JPL intends that the Contractor submit material which is already in electronic form via ‘Magnetic Media’ (e.g., word processing documents that are already in Microsoft Word). Accordingly, the media and format requirements for MM submittals are as follows:

| | |
|-------------------------------|-------------------------|
| Disk Size: | 3-1/2” floppy disk |
| Disk Format: | PC |
| File Format, Word Processing: | Word 2000 |
| File Format, Spreadsheet: | Excel 2000 |
| File Format, Schedule(s): | Project 2000 |
| File Format, Drawings: | AutoCAD, and VISIO 2000 |

The Contractor shall, with JPL approval, establish a baseline MM disk and file format from the choices above, or as negotiated, as soon after Award of Contract as practicable. This baseline shall only be modified in writing by mutual consent of both parties. As an alternative to floppy disks, use of electronic mail to deliver CDRL items and other files or optical means (such as Compact Disk Read Only Memory (CD-ROM) formatted for PC) are permitted as specifically requested by JPL and noted in the CDRL remark section (Block 10).

JPL intends that the Contractor deliver other MM files (in addition to those identified in CDRL Block 9) wherever possible. Specific documents and deliverables can be negotiated at a later date. JPL intends that the Contractor provide as many deliverables as possible in the MM format, provided that such delivery is practical and does not result in unnecessary expenses.

The term “copies” refers to clean, legible copies of the CDRL item. A reduced set of copies is requested (two copies) when the original deliverable is via MM.

Abbreviations and Acronyms

| | |
|-------|---|
| A | JPL Approval Required; Amperes |
| AC | Alternating Current |
| A/D | Analog-to Digital |
| ADC | Analog-to Digital Conversion |
| ADOC | After Date of Contract |
| AGP | Additional General Provision |
| AIDS | Assembly, Inspection, and Data Sheet |
| ARJC | After Receipt of JPL Comments |
| A/R | As Required |
| C | Degrees Celsius |
| CDR | Critical Design Review |
| CDRL | Contract Data Requirements List |
| CG | Center of Gravity |
| CM | Configuration Management |
| D | JPL Document (JPL D-xxxx) |
| DC | Direct Current |
| DCAA | Defense Contracts Audit Agency |
| DOD | Department of Defense |
| DPA | Destructive Physical Analysis |
| DRD | Data Requirement Description |
| DRR | Design Requirements Review |
| DS | Design |
| EACS | Environmental Analysis Completion Statement |
| BPM | Baseband Processor Module |
| ECI | Engineering Change Instruction |
| ECR | Engineering Change Request |
| EIA | Electronic Industries Association |
| EIDP | End-Item Data Package |
| EMC | Electromagnetic Compatibility |
| EMI | Electromagnetic Interference |
| ENV | Environmental |
| PSM | Power Supply Module |
| ESD | Electrostatic Discharge |
| RFM | Radio Frequency Module |
| FA | Flight Acceptance |
| FAX | Facsimile |
| FED | Federal |
| FITS | Failure in Time |
| FLT | Flight |
| FMECA | Failure Mode Effects and Criticality Analysis |
| FM | Flight Model |
| FRD | Functional Requirements Document |
| FS | Fabrication Specification |
| FSS | Flight Safety Survey |
| FTA | Fault Tree Analysis |
| G&A | General and Administrative |
| GEN | General |
| GFP | Government Furnished Property |
| GIDEP | Government Industry Data Exchange Program |

Abbreviations and Acronyms (continued)

| | |
|-------|---|
| GSE | Government Supplied Equipment |
| HRCR | Hardware Review/Certification Requirement |
| IAW | In Accordance With |
| ICD | Interface Control Drawing; Interface Control Document; Installation Control Drawing |
| ID | Inner Diameter; Identification |
| IP | Intellectual Property |
| JPL | Jet Propulsion Laboratory |
| LNA | Low Noise Amplifier- |
| LO | Local Oscillator |
| MA | Management |
| MICD | Mechanical Interface Control Drawing |
| MIUL | Materials Identification |
| MM | Magnetic Media |
| MMR | Monthly Management Review |
| MP | Materials and Processes |
| M&P | Materials and Processes |
| MRB | Material Review Board |
| MTO | Mars Telecom Orbiter |
| MTTF | Mean Time Till Failure |
| MUA | Material Usage Agreement |
| MUPA | Mars UHF Proximity Antenna |
| NASA | National Aeronautics and Space Administration |
| NCR | Non-Conformance Report |
| NHB | NASA Handbook |
| NSPAR | Non-Standard Part Approval Request |
| ORIG | Original |
| OSHA | Occupational and Safety Health Act |
| PA | Parts |
| P/FR | Problem/Failure Report |
| PD | Project Document |
| PDR | Preliminary Design Report |
| PERT | Performance Evaluation Review Technique |
| PIP | Proposal Information Package |
| PMS | Performance Measurement System |
| P/O | Part of |
| PSA | Parts Stress Analysis |
| PSR | Pre-Ship Review |
| QA | Quality Assurance |
| QMR | Quarterly Management Review |
| RA | Reliability Assurance |
| RE | Review |
| RCVR | Receiver |
| RF | Radio Frequency |
| SA | Safety |
| SC | Spare Components |
| SDST | Small Deep Space Transponder |
| SE | Support Equipment |
| SECR | Support Equipment Certification Requirement |
| SEE | Single Event Effect |
| SEL | Single Event Latchup |

Abbreviations and Acronyms (continued)

| | |
|------|---|
| SEU | Single Event Upset |
| SNR | Signal to Noise Ratio |
| SPF | Single Point Failure |
| SRD | Software Requirements Document |
| SRCR | Software Review/Certification Requirement |
| SRP | Subcontractor Review Plan |
| SS | System Safety |
| S/S | System Software |
| ST | Standard |
| STD | Standard |
| STE | Special Test Equipment |
| STM | Structural/Thermal Model |
| STP | Standard Temperature and Pressure |
| SW | Software |
| TBD | To Be Determined |
| TBR | To Be Resolved |
| TBS | To Be Supplied |
| TD | Technical Document |
| TDM | Technical Direction Memorandum |
| TE | Test |
| TID | Total Ionizing Dose |
| TIM | Technical Interchange Meeting |
| T/R | Transmit/Receive |
| TRSF | Test Result Summary Form |
| T/V | Thermal-Vacuum |
| TX | Transmit |
| UHF | Utral High Frequency |
| V | Volts |
| VDC | Volts Direct Current |
| Vdc | Volts Direct Current |
| VSWR | Voltage Standing Wave Ratio |
| WAC | Weeks After Completion |
| WBS | Work Breakdown Structure |
| W | Watts |
| WCA | Worst Case Analysis |
| X | JPL Approval Not Required |
| XBM | X Band Module |

Contract Data Requirements List (CDRL) Summary

| | |
|--------------------------------------|---|
| MATERIALS AND PROCESSESS (MP) | |
| MP-001 | Materials and Processes Control Plan |
| MP-002 | Material and Processes Data |
| PARTS (PA) | |
| PA-001 | Parts Program Plan |
| PA-002 | Electronics Parts Data |
| QUALITY ASSURANCE (QA) | |
| QA-001 | Quality Assurance Plan and Documentation |
| QA-002 | End-Item-Data-Package |
| QA-003 | Assembly and Test Workflow |
| RELIABILITY ASSURANCE (RA) | |
| RA-001 | Problem/Failure Reports |
| RA-002 | Failure Mode, Effects, and Criticality Analysis (FMECA) |
| RA-003 | Mechanical/Electromechanical Fault Tree Analysis (FTA) |
| RA-004 | Thermal Stress Analysis |
| RA-005 | Structural Stress Analysis |
| REPORTS and REVIEWS (RE) | |
| RE-001 | Preliminary Design Report |
| RE-002 | Parametric Study Report |
| RE-003 | Critical Design Review |
| TECHNICAL DOCUMENTS (TD) | |
| TD-001 | Thermal Model Data and Documentation |
| TD-002 | Dynamic Model Data and Documentation |
| TEST (TE) | |
| TE-001 | Test Procedures |
| TE-002 | Requirement Verification and Test Plan |
| TE-003 | Environmental Test Plan |

| 1. CONTRACT NUMBER | | 1. CONTRACTOR | | | 2a. PROJECT: | | | |
|--------------------|------------------|--|---------------|-----------------------|---------------------------------|-------------------------------|---|---------------------|
| TBD | | TBD | | | Mars Telecom Orbiter (MTO) | | | |
| 3. ITEM NO. | 4. DRD NO. | 5. TITLE OR DESCRIPTION OF DATA | 6. APPR. CODE | 7. FREQUENCY OF ISSUE | 8. DATE DUE TO JPL | 9. QUANTITY COPIES VIA E-MAIL | | 10. REMARKS |
| | <u>MP</u> | <u>Materials and Processes Control Plan</u> | | | | | | |
| 1. | MP 001 | Materials and Processes Control Plan | | | | | | |
| | | Draft | X | Once | 2 months ADOC | 2 | 1 | Applicable to Basic |
| | | Final | A | Once | 3 weeks after approval of Draft | 2 | 1 | Applicable to Basic |

| 1. CONTRACT NUMBER | | 1. CONTRACTOR | | | 2a. PROJECT: | | | |
|--------------------|------------|---|---------------|-----------------------|-----------------------------------|-------------------------------|---|---|
| TBD | | TBD | | | Mars Telecom Orbiter (MTO) | | | |
| 3. ITEM NO. | 4. DRD NO. | 5. TITLE OR DESCRIPTION OF DATA | 6. APPR. CODE | 7. FREQUENCY OF ISSUE | 8. DATE DUE TO JPL | 9. QUANTITY COPIES VIA E-MAIL | | 10. REMARKS |
| 2. | MP 002 | Materials and Processes Data | | | | | | |
| | | MIULs, Preliminary | A | Once | 1 month prior to PDR | 2 | 1 | Applicable to Basic Applicable to Opt. 2 |
| | | MIULs Final | A | Once | 1 month prior to CDR | | | |
| | | MIULs Updates | A | As Required | As Required | | | |
| | | Contractor preferred fasteners list | X | Once | 1 month prior to PDR | 2 | 1 | Applicable to Basic |
| | | Contractor fastened selection and traceability requirements | X | Once | 1 month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Material Usage Agreements | A | As Required | 10 days after completion | 2 | 1 | For all phases as applicable |
| | | Failure Analysis Report | X | Per Occurrence | 1 week after completion of report | 2 | 1 | For all phases as applicable |
| | PA | Parts | | | | | | |
| 1. | PA 001 | Parts Program Plan | | | | | | |
| | | Draft | A | Once | 1 Month ADOC | 2 | 1 | Applicable to Basic |
| | | Final | X | Once | 2 weeks after approval of Draft | 2 | 1 | Applicable to Basic |

| 1. CONTRACT NUMBER TBD | | 1. CONTRACTOR TBD | | | 2a. PROJECT: Mars Telecom Orbiter (MTO) | | | |
|---------------------------|------------------|--|---------------|-----------------------|--|-------------------------------|---|----------------------|
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| 2. | PA 002 | Electronic Parts Data | | | | | | |
| | | Preliminary Design Parts List | A | Once | 1 Month ADOC | 2 | 1 | Applicable to Basic |
| | | Updates to Preliminary Design Parts List | A | Every 2 Months | 2 Months after first release | 2 | 1 | Applicable to Basic |
| | | “As-Designed” Parts List | A | Once | 1 month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Preliminary “As-Built” Parts List | A | Once | 1 Month prior to Acceptance Testing | 2 | 1 | Applicable to Opt. 2 |
| | | Final “As-Built” Parts List | A | Once | With EIDP delivery | 2 | 1 | |
| | <u>QA</u> | <u>Quality Assurance</u> | | | | | | |
| 1. | QA 001 | Quality Assurance Plan and Documentation | | | | | | |
| | | Final | A | Once | 3 Weeks after Option 1 | 2 | 1 | Applicable to Opt. 1 |

| 1. CONTRACT NUMBER | | 1. CONTRACTOR | | | 2a. PROJECT: | | | |
|--------------------|------------------|-------------------------------------|---------------|-----------------------|------------------------------------|-------------------------------|---|---|
| TBD | | TBD | | | Mars Telecom Orbiter (MTO) | | | |
| 3. ITEM NO. | 4. DRD NO. | 5. TITLE OR DESCRIPTION OF DATA | 6. APPR. CODE | 7. FREQUENCY OF ISSUE | 8. DATE DUE TO JPL | 9. QUANTITY COPIES VIA E-MAIL | | 10. REMARKS |
| 2. | QA 002 | End Item Data Package (EIDP) | | | | | | Applicable to Opt. 3 |
| | | Draft | X | Once | 1 Week prior to acceptance testing | 2 | | Provide EIDP (all or portions as appropriate) via MM Each EIDP Original to be delivered to JPL |
| | | Final | A | Once | At acceptance testing | 2 | | |
| 3. | QA 003 | Assembly and Test Workflow | | | | | | |
| | | Final (Applicable to Breadboard) | A | Once | 3 Weeks after Option 1 | 2 | 1 | Applicable to Opt. 1 |
| | | Final (Applicable to EM) | A | Once | 8 Weeks after Option 2 | 2 | 1 | Applicable to Opt. 2 |
| | <u>RA</u> | <u>Reliability Assurance</u> | | | | | | |
| 1. | RA 001 | Problem/Failure Reports | | | | | | Applicable to Opt. 1 & 2 |
| | | Initial | A | Once | Within 2 days of occurrence | 2 | 1 | Applies to each P/FR. Applies to each P/FR. |
| | | Final | A | Once | Within 2 days of closure | 2 | 1 | |

| 1. CONTRACT NUMBER | | 1. CONTRACTOR | | | 2a. PROJECT: | | | |
|--------------------|------------|--|---------------|-----------------------|----------------------------|-------------------------------|---|----------------------|
| TBD | | TBD | | | Mars Telecom Orbiter (MTO) | | | |
| 3. ITEM NO. | 4. DRD NO. | 5. TITLE OR DESCRIPTION OF DATA | 6. APPR. CODE | 7. FREQUENCY OF ISSUE | 8. DATE DUE TO JPL | 9. QUANTITY COPIES VIA E-MAIL | | 10. REMARKS |
| 2. | RA 002 | Failure Mode Effects and Criticality Analysis (FMECA) | | | | | | |
| | | Draft | A | Once | 10 Weeks after Option 2 | 2 | 1 | Applicable to Opt. 2 |
| | | Final | X | Once | 1 Month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Revisions | A | As required | As required | 2 | 1 | |
| 3. | RA 003 | Mechanical/Electromechanical Fault Tree Analysis (FTA) | | | | | | |
| | | Draft | A | Once | 10 Weeks after Option 2 | 2 | 1 | Applicable to Opt. 2 |
| | | Final | X | Once | 1 Month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Revisions | A | As required | As required | 2 | 1 | |

| 1. CONTRACT NUMBER TBD | | 1. CONTRACTOR TBD | | | 2a. PROJECT: Mars Telecom Orbiter (MTO) | | | |
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| 4. | RA 004 | Thermal Stress Analysis | | | | | | |
| | | Draft | A | Once | 10 Weeks after Option 2 | 2 | 1 | Applicable to Opt. 2 |
| | | Final | X | Once | 1 Month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Revisions | A | As required | As required | 2 | 1 | |
| 5. | RA 005 | Structural Stress Analysis | | | | | | |
| | | Draft | A | Once | 10 Weeks after Option 2 | 2 | 1 | Applicable to Opt. 2 |
| | | Final | X | Once | 1 Month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Revisions | A | As required | As required | 2 | 1 | |
| | <u>RE</u> | <u>Reports and Reviews</u> | | | | | | |
| 1. | RE 001 | Preliminary Design Report | A | Once | 5 Months ADOC | 4 | 1 | |
| 2. | RE 002 | Parametric Study Report | A | Once | 3 Months ADOC | 4 | 1 | |

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| 3. | RE 003 | Critical Design Review | A | Once | 4 Months after Opt. 2 | 4 | 1 | Applicable to Opt. 2 |
| | <u>TD</u> | <u>Technical Document</u> | | | | | | |
| 1. | TD 001 | Thermal Model Data and Documentation | | | | | | |
| | | Draft | A | Once | 10 Weeks after Option 2 | 2 | 1 | Applicable to Opt. 2 |
| | | Final | X | Once | 1 Month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Revisions | A | As required | As required | 2 | 1 | |
| 2. | TD 002 | Dynamic Model Data and Documentation | | | | | | |
| | | Draft | A | Once | 10 Weeks after Option 2 | 2 | 1 | Applicable to Opt. 2 |
| | | Final | X | Once | 1 Month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Revisions | A | As required | As required | 2 | 1 | |

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|--------------------|------------|--|---------------|-----------------------|----------------------------|-------------------------------|---|----------------------|
| TBD | | TBD | | | Mars Telecom Orbiter (MTO) | | | |
| 3. ITEM NO. | 4. DRD NO. | 5. TITLE OR DESCRIPTION OF DATA | 6. APPR. CODE | 7. FREQUENCY OF ISSUE | 8. DATE DUE TO JPL | 9. QUANTITY COPIES VIA E-MAIL | | 10. REMARKS |
| | TE | Test | | | | | | |
| 1. | TE 001 | Test Procedures | | | | | | |
| | | Draft | X | Once | 3 Months after Option 1 | 2 | 1 | Applicable to Opt. 1 |
| | | Final | A | Once for test | 4 Months after Option 1 | 2 | 1 | Applicable to Opt. 1 |
| | | | | | | | | Original Copies |
| 2. | TE 002 | Requirement Verification and Test Plan | | | | | | |
| | | Draft | X | Once | 3 Months after Option 1 | 2 | 1 | Applicable to Opt. 1 |
| | | Final | A | Once | 4 Months after Option 1 | 2 | 1 | Applicable to Opt. 1 |
| | | Updates | A | Once | As required | 2 | 1 | Applicable to Opt. 2 |
| 3. | TE 003 | Environmental Test Plan | | | | | | |
| | | Draft | X | Once | 1 Month prior to CDR | 2 | 1 | Applicable to Opt. 2 |
| | | Final | A | Once | 1 Months prior to Testing | 2 | 1 | Applicable to Opt. 2 |

DATA REQUIREMENT DESCRIPTION

| | |
|---|--|
| TITLE Materials and Processes Control Plan | NUMBER MP-001 Page 1 of 1 |
| USE Describes the requirements, documentation, analyses, evaluation and testing of the materials and processes used for fabrication. | PROGRAM Mars UHF Proximity Antenna (MUPA) |
| INTERRELATIONSHIP | REFERENCES |
| PREPARATION INFORMATION PREPARATION OF INFORMATION: <p>The Contractor shall prepare a Materials and Processes Control Plan in accordance with the Materials and Processes requirements in the MTO Mission Assurance Plan. The plan shall describe the Contractor's materials and process requirements and practices, including references to Contractor's applicable institutional policies, procedures, specifications, and instructions. It shall also include the following:</p> <ol style="list-style-type: none"> 1. Document Change Log 2. Table of Contents 3. Purpose, scope, and applicability of plan 4. List of applicable documents 5. A description of the materials and processes engineering/assurance organization, management, approach, and responsibilities for accomplishing the various activities, as well as relationships to the elements of the Contractor's organization and its institutional organizations. 6. A description of the means for selection (including sources) of materials and processes, including criteria for qualification/evaluation plans. 7. A description of contents, use, and schedules for Materials Identification and Usage Lists (MIULs) and classifications of listed items; descriptions of the contents and use of Materials Usage Agreements (MUAs) and waivers; and templates for each of these forms. 8. A description of requirements, including sources materials and processes selection criteria, and guidelines for implementation. 9. A schedule of materials and processes engineering/assurance activities indicating their phase relationships with design, development, procurements, design reviews, hardware reviews, fabrication, system testing, and shipment. 10. A description of responsibilities and techniques for accomplishing materials and processes engineering/assurance activities by or with subcontractors and suppliers. 11. A description of how the Contractor will impose all requirements by appropriate documents on all subcontractors and suppliers. <p>Contractor's existing Materials and Processes Control Plan, tailored to the MTO Project, may be submitted for JPL Materials and Processes Control Plan assessment for adequacy in meeting the intent of this document. The document(s) submitted by the Contractor will be reviewed by JPL, and upon approval, will become the applicable documents for the Contract.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|---|---|
| <p>TITLE</p> <p>Materials and Processes Data</p> | <p>NUMBER</p> <p>MP-002 Page 1 of 1</p> |
| <p>USE</p> <p>Lists and provides data, plans, and reports pertaining to the materials and processes that are to be used in the design and fabrication of hardware.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>Prepare and submit data in accordance with the following:</p> <ol style="list-style-type: none"> (1) Materials Identification and Usage Lists (MIULs) for all mechanical parts, electronic parts, materials and processes that are to be used in the design and fabrication of flight hardware. Information that shall be provided in the MIULs is described in the MTO Mission Assurance Plan. The evaluation and selection of materials and processes for inclusion in the MIULs shall be according to the requirements and guidelines of JPL MTO Mission Assurance Plan. The Contractor shall prepare the form using the attached MIUL template or the Contractor's equivalent document (NA for EM Unit). (2) Contractor preferred fasteners list (3) Contractor fastener selection and traceability requirements (4) Materials Usage Agreements (MUAs) or waivers that pertain to material and process issues, and all associated back-up information. The Contractor shall prepare the form using the attached MUA form template or the Contractor's equivalent document (n/a for EM Unit) (5) Failure analysis reports, which involve materials and processes issues (6) Contractor applicable documents requiring JPL approval for equivalence <p>Attached: Sample template for MIULs; sample template for MUAs; stress corrosion evaluation form.</p> <p>Note: For the EM units, the above information / documentation are on an “as available” basis only.</p> <p>DRD-01</p> | |

DRD MP-002 Sample MUA

| | | | | | | | |
|--|--------|---------------------|-----------------|------------------|-----------------|-------------------|--|
| MATERIALS USAGE AGREEMENT | | USAGE AGREEMENT NO. | | REVISION | | PAGE OF | |
| PROJECT: | | SUBSYSTEM | | ORIGINATOR | | ORGANIZATION: JPL | |
| DETAIL DRAWING(S) | | USING ASSEMBLY(IES) | | ITEM DESCRIPTION | | ISSUE | |
| MATERIAL | | TRADE NAME | | SPECIFICATION | | MANUFACTURER | |
| THICKNES S | WEIGHT | EXPOSED AREA | LOCATION | ENVIRONMENT | | | |
| | | | HABITABLE | PRESSUR E | TEMPERATUR E | MEDIA | |
| | | | NONHABITABLE | | | | |
| APPLICATION | | | | | | | |
| RATIONALE | | | | | | | |
| ORIGINATOR | | | PROGRAM MANAGER | | | DATE | |
| FLIGHT MATERIALS AND PROCESSES ENGINEERING, JPL | | | | | | | |
| MATERIALS ENGINEERING EVALUATION | | | | | | | |
| | | | | | | | |

**DRD MP-002 Sample
STRESS CORROSION EVALUATION FORM**

1. PART NUMBER _____
2. PART NAME _____
3. NEXT ASSEMBLY NUMBER _____
4. MANUFACTURER _____
5. MATERIAL _____
6. HEAT TREATMENT _____
7. SIZE AND FORM _____
8. SUSTAINED TENSILE STRESS-MAGNITUDE AND DIRECTION
 - a. PROCESS RESIDUAL _____
 - b. ASSEMBLY _____
 - c. DESIGN, STATIC _____
9. SPECIAL PROCESSING _____
10. WELDMENTS
 - a. ALLOY FORM, TEMPER OF PARENT METAL _____
 - b. FILLER ALLOY IF NONE, INDICATE _____
 - c. WELDING PROCESS _____
 - d. WELD BEAD REMOVAL - YES (), NO () _____
 - e. POST-WELD THERMAL TREATMENT _____
 - f. POST-WELD STRESS RELIEF _____
11. ENVIRONMENT _____
12. PROTECTIVE FINISH _____
13. FUNCTION OF PART _____

14. EFFECT OF FAILURE _____

15. EVALUATION OF STRESS CORROSION SUSCEPTIBILITY _____

16. REMARKS _____

DRD MP-002 Sample MIUL
 Nonmetallic Materials

| Item No. | Material Description/ Brand Name Supplier | Application | Material Specifications | Thermal Vacuum Stability (%) | JPL Rating ¹ | Comments |
|----------|---|-------------|-------------------------|------------------------------|-------------------------|----------|
| 1 | | | | TML = CVCM = WVR = | | |
| 2 | | | | TML = CVCM = WVR = | | |
| 3 | | | | TML = CVCM = WVR = | | |
| 4 | | | | TML = CVCM = WVR = | | |
| 5 | | | | TML = CVCM = WVR = | | |
| 6 | | | | TML = CVCM = WVR = | | |
| 7 | | | | TML = CVCM = WVR = | | |
| | | | | | | |

¹ 1 – acceptable, 2 – qualified acceptable, 3 – provisionally acceptable, 4 – unacceptable

DRD MP-002 Sample MIUL

Metallic Materials

| Item No. | Material Description/ Condition | Application | Material Specifications | Stress Corrosion Cracking Rating | JPL Rating ¹ | Comments |
|----------|---------------------------------|-------------|-------------------------|----------------------------------|-------------------------|----------|
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |

¹ 1 – acceptable, 2 – qualified acceptable, 3 – provisionally acceptable, 4 – unacceptable

DRD MP-002 Sample Processes

| Item No. | Process | Specification | Materials Processed | Spacecraft/ Experiment Application | JPL Evaluation | |
|----------|---------|---------------|---------------------|------------------------------------|----------------------------------|----------|
| | | | | | Approve/ Disapprove ¹ | Comments |
| 1 | | | | | | |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |
| 5 | | | | | | |
| 6 | | | | | | |

¹ 1 – acceptable, 2 – qualified acceptable, 3 – provisionally acceptable, 4 – unacceptable

DATA REQUIREMENT DESCRIPTION

| | |
|--|---|
| <p>TITLE</p> <p>Parts Program Plan</p> | <p>NUMBER</p> <p>PA-001 Page 1 of 1</p> |
| <p>USE</p> <p>To define the parts control activities.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> <p>(JPL D-TBD) MTO Parts Program Requirements</p> |
| <p>PREPARATION INFORMATION</p> <p>The Contractor shall develop a Parts Control Plan that meets the requirements of JPL D-TBD (MTO Parts Program Requirements).</p> <p>Contractor's existing Parts Program Plan, tailored to the MTO Project, may be submitted for JPL Parts Program Plan assessment for adequacy in meeting the intent of this document. The document(s) submitted by the Contractor will be reviewed by JPL, and upon approval, will become the applicable documents for the Contract.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|---|--|
| <p>TITLE</p> <p>Electronic Parts Data</p> | <p>NUMBER</p> <p>PA-002 Page 1 of 1</p> |
| <p>USE</p> <p>To provide data on electronic parts for the proposed design.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>The Contractor shall submit technical data as defined by the Parts Control Plan (EM only), which covers item selection, application status and problems/concerns during selection, procurement, design/development, fabrication and testing. These data shall consist of the following as an example:</p> <ol style="list-style-type: none"> (1) Electronic Parts Lists including manufacturer’s part number, generic part number, proposed manufacturer, procurement specification, screening/demonstration/upgrade specification, applicable NSPARs/waivers with revision letter and status, single string/redundant system designation, mission critical or non-critical designation, and quantities used, preferably in an excel format. (2) Nonstandard Part Approval Requests (NSPARs) and all associated procurement and screening/demonstration (test) documentation. (3) Waivers and all associated backup information. (4) Failure Analysis reports on any parts used for the units on any catastrophic screening or any failures. (5) DPA reports for lots that fail DPA. (6) Lot Data Books including screening data and other data required of the part supplier. (Do not deliver these data to JPL but retain them at the Contractor’s facility.) (7) GIDEP Alert Review and Status Report. Electronic Parts Non-Conforming Material Report (NCRM) Action and Status Report <p>Note: For the EM units, the information for the item #1 above can be included as a part of the EM unit “Bill Of Material” (as outlined also in QA-002) and are required if the specific information on the part used is available. Items #2 through # 6 and item #8 are on an “as applicable” basis only. Item # 7 is required.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|---|--|
| <p>TITLE</p> <p>Quality Assurance Plan and Documentation</p> | <p>NUMBER</p> <p>QA-001 Page 1 of 2</p> |
| <p>USE</p> <p>To define and describe the Quality Assurance (QA) Program</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>The Plan shall include the following:</p> <ol style="list-style-type: none"> 1. Narrative explanations of the QA system’s compliance with the intent of ISO 9001 including methods used, when they are applied, and who performs them. 2. Indication in the plan of proper flow down of all customer requirements to sub-tier vendors to ensure they comply with intent of customer requirements. 3. A description of existing applicable Contractor QA policies and instructions. 4. Organization charts and narrative statements describing the functions, responsibilities, and relationships of each element in the Contractor’s quality organization. Include procurement, engineering, fabrication, test, and quality control. 5. A description of the QA interfaces between JPL and the Contractor, between the Contractor and its suppliers, and between Contractor interdivisional quality organizations. 6. A description of Contamination Control Procedures utilized by the Contractor that address materials selection, corrosion prevention, cleaning, cleanliness maintenance, handling, packaging and storage of deliverable hardware and equipment. 7. A description of QA support of Manufacturing Planning and Drawing Reviews, parts and materials screening. 8. A listing and description of all workmanship standards used in support of all deliverable hardware and equipment. 9. A description of QA support of support and test equipment. 10. A description of QA support of functional and environmental testing. 11. A description of QA activities in support of procured hardware. 12. A description of QA documentation and data. 13. A flow chart of Inspection and test activities indicating potential customer hold points for customer approval. 14. Indication in the plan for training and certification of personnel in critical processes. These include but are not limited to: plating, anodizing, heat treating, welding, soldering, polymeric applications, cleaning, die attachment, wire bonding, Magnetic particle inspection, ultrasonic inspection and liquid penetrant inspection. | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|---|---|
| TITLE Quality Assurance Plan and Documentation | NUMBER QA-001 Page 2 of 2 |
| PREPARATION INFORMATION 15. Indication in the plan that sub-tier vendors are qualified in the above critical processes. 16. All processes used such as Electro-Static Discharge control plan, workmanship standard, contamination control plan shall be qualified in accordance with NASA, JPL requirements or Contractors equivalent specifications. 17. Indications in the plan for retaining of quality controlled records. These are records that furnish objective evidence of, activities performed or results achieved relating to fabrication, assembly, integration and test of hardware. These include drawings, manuals, specifications and other written documentation relating to the design development, manufacture and test of hardware. 18. Indications in the plan to provide for proper handling, packaging, shipping and storage of critical hardware. 19. Indications in the plan for proper segregation of non-conforming material. Provisions to prevent co-mingling of these parts with acceptable hardware will also be evident. Contractor's existing Quality Assurance Plan and Documentation, tailored to the MTO Project, may be submitted for JPL Quality Assurance Plan and Documentation assessment for adequacy in meeting the intent of this document. The document(s) submitted by the Contractor will be reviewed by JPL, and upon approval, will become the applicable documents for the Contract. | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|--|---|
| TITLE End-Item-Data Package | NUMBER QA-002 Page 1 of 2 |
| USE To document the design, build, assembly, and test of the MUPA Deliverable | PROGRAM Mars UHF Proximity Antenna (MUPA) |
| INTERRELATIONSHIP DRDs: QA-001 | REFERENCES |

PREPARATION INFORMATION

An End-Item Data Package (EIDP) shall be prepared by the Contractor for each hardware assembly that is to be delivered. The form of the package is determined by the Contractor. The contents of the package shall include, but not limited to, the following information:

Mars UHF Proximity Antenna

1. As-Built data for all hardware. “As-Built” documentation is a compilation of items describing exactly the configuration of a fabricated serialized assembly, including:

Hardware:

- a. Part number and revision letter of each item.
- b. Part description (title) of each item.
- c. Electronic part reference designation.
- d. Serial number of each item, or if no serial number, the screening lot number when required.
- e. Screening/demonstration / upgrade lot number, as applicable.
- f. Procurement specification.
- g. Generic part number.
- h. Manufacturer.
- i. Applicable NSPAR and Waiver numbers (with latest revision letter).
- j. Manufacturer code.
- k. Traceability number, as applicable.
- l. Serial number and part number of the next assembly level into which the part is installed.

Note I: Data required in Item1 shall be submitted via email and hard copy and shall include vendor as-built data for hybrids and procured subassemblies.

Note II: For the EM unit, items ‘a’ through item ‘e’ and items g, h, j, k can be included as a part of the EM units “Bill Of Material” and are required if the specific information on the parts used are available.

DRD-01

DATA REQUIREMENT DESCRIPTION

| TITLE | NUMBER |
|--|-------------------------------------|
| End-Item- Data Package | QA-002 Page 2 of 2 |
| PREPARATION INFORMATION | |
| <ol style="list-style-type: none"> 2. A complete shortage list (parts and activities, as applicable). 3. Operating time data on all major assemblies and time sensitive items. 4. Number of operations for operationally limited items. 5. A complete list of the tests and test results performed at module, sub-assembly, and assembly, with test data (last acceptance test at each level as a minimum) organized and indexed to the list. 6. A summary list, including open and closed status, of all P / FRs generated against the deliverable. 7. A summary list, including open and closed status, of all MRB actions generated against the deliverable. 8. A summary list, including open and closed status, of all ECRs generated against the deliverable. 9. A summary list of all deviations and waivers applicable to the deliverable item. 10. Configuration Assembly Log (for both hardware and software as applicable). 11. Removable/re-installation record (not applicable for SE and test equipment). 12. Evidence of acceptance by Contractor QA. 13. Test result summary and reports to include all tests performed (for both hardware and software as applicable). 14. Environmental test reports (on test environment) including JPL ETSS and TRSF completed forms. 15. Vendor / manufacturer parts and material certification forms and detail data, as applicable. 16. Unique instructions for safety, handling, packaging, storage, and shipping, as applicable. 17. Precap photographs for each assembly. 18. A one time delivery, with updates as required: <ol style="list-style-type: none"> a. A copy of all Environmental Analysis. b. A copy of the Packaging Qualification Verification Report. c. A complete and up-to-date top assembly drawing of each type of delivery. d. A complete and up-to-date mechanical and electrical ICDs for each delivery. e. For electronic assemblies, a complete set of circuit schematics and circuit data sheets. f. Complete set of manufacturing drawings. | |

DRD-02

DATA REQUIREMENT DESCRIPTION

| | |
|--|--|
| <p>TITLE</p> <p>Assembly and Test Workflow</p> | <p>NUMBER</p> <p>QA-003 Page 1 of 1</p> |
| <p>USE</p> <p>To provide inputs for JPL QA for Mandatory Inspection Points.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>The Assembly and Test workflow shall be submitted for JPL review and insertion of in process, test and final inspection hold points.</p> <p>These points are designed to allow inspection of critical processes prior to operations that will limit the ability to inspect later or are areas of concern for reliability reasons. These points should be agreed upon between JPL and the contractor so as to not unduly disrupt the workflow or cause significant schedule delays.</p> <p>Examples of points to be added <i>may</i> include:</p> <ul style="list-style-type: none"> In process assembly Test setup verification Witnessing of thermal vacuum test setup Witnessing of vibration test Witnessing of Final Functional test Pre ship review of documentation Final inspection prior to ship <p>Three days notification is required prior to Mandatory Inspection Points to allow for schedule and travel arrangements to be worked out.</p> <p>Note: For the EM unit, JPL at minimum, shall require a pre-ship review of documentation and shall conduct a final inspection prior to shipment.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|--|--|
| <p>TITLE</p> <p>Problem/Failure Reports</p> | <p>NUMBER</p> <p>RA-001 Page 1 of 1</p> |
| <p>USE</p> <p>To provide JPL with timely notice of anomalies, problems or failures with the Contractor's software or hardware. Also, to provide JPL with the data necessary to assess the adequacy of the analysis and corrective action, so as to prevent recurrence of anomalies, problem/failures and to assess the residual risk following corrective action.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> <p>JPL D-5703</p> |
| <p>PREPARATION INFORMATION</p> <p>Each anomaly/problem/failure report shall be responsive to the requirements of the MTO Mission Assurance Plan and shall be submitted in accordance with JPL D-5703. The reports shall include but not be limited to the following:</p> <ol style="list-style-type: none"> 1. Complete identification of the hardware/software; 2. Date the anomaly, Problem/failure occurred; 3. Estimated operating hours and/or cycles at the time the problem/failure occurred; 4. Location of the hardware at occurrence; 5. Hardware environmental conditions when the problem/failure occurred; 6. Test/operation being performed; 7. A description of the problem/failure incident and the potential impact on the assembly/subsystem/system functional performance; 8. A description of the problem/failure analysis, including impact on hardware/software; 9. Cause of the problem/failure; 10. A description of the corrective action taken; 11. A description of the method used to verify that the corrective action was effective 12. Safety rating; 13. Numeric rating of the failure effect on the Contractor's hardware – NOTE: Redundancy shall not be considered in making this assessment; 14. Numeric rating of the failure risk (confidence in the effectiveness of the corrective action) on the Contractor's hardware; 15. Supporting material shall be provided to allow JPL to perform the mission risk assessment; 16. Appropriate closeout signatures. | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|--|--|
| <p>TITLE</p> <p>Failure Mode Effects and Criticality Analysis (FMECA)</p> | <p>NUMBER</p> <p>RA-002 Page 1 of 3</p> |
| <p>USE</p> <p>The purpose of the FMECA is to identify potential hardware design deficiencies prior to fabrication of hardware.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>The FMECA shall be performed at the piece part level for all test equipment interface circuits to preclude any propagation of irreversible flight hardware failures. Such analysis shall be done for the MUPA to the extent that knowledge of software/firmware functionality is not required.</p> <p>Test equipment shall include, but not limited to, all non-flight test fixtures, bench checkout equipment, bench test equipment, special test equipment, and test boxes, that interface directly or indirectly to a flight MUPA hardware.</p> <p>The specific FMECA subjects to be addressed are given in Table 1, <i>Minimum Part Failure Mode Assumptions</i>.</p> <p>1. Steps in Performing FMECA</p> <p>a. Failure Definition:</p> <p>Rigorous failure definitions must be established for the flight hardware. As a minimum, the part failure modes to be assumed are given in Table 1.</p> <p>b. Failure Effect Analysis:</p> <p>This takes into account each different failure mode (identified in Table 1) and indicates the effect of those items' failure effect upon the flight MUPA hardware performance. An example summary form is provided in Table 2, <i>Example Failure Modes, Effects, and Analysis Form</i>.</p> <p>2. Identification of Critical Failure</p> <p>A list of critical items shall be prepared from the failure effects analysis, Table 2. This list contains those items whose failure can result in a possible loss, probable loss, certain loss, or damage of the flight hardware.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| TITLE Failure Mode Effects and Criticality Analysis (FMECA) | NUMBER RA-002 Page 2 of 3 | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--|----------------|---------------------|---------------|---|---------------------|----------------------------|----------|--------------|---------------|--|-----------|-------------------------------|---------------------------------|---|-----------------------------|--|--------------|--------------|---------------------|---------------------------------------|----------------------|--|------------------|---------------------------|--------------------------|---|
| INTERRELATIONSHIP | REFERENCES Mars UHF Proximity Antenna (MUPA) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PREPARATION INFORMATION <p style="text-align: center;">Table 1. Minimum Part Failure Mode Assumptions</p> <table border="0"> <thead> <tr> <th style="text-align: left;"><u>1. Part</u></th> <th style="text-align: left;"><u>Failure Mode</u></th> </tr> </thead> <tbody> <tr> <td>1. Capacitors</td> <td>Short Circuit Excessive leakage (electrolytic) Open circuit</td> </tr> <tr> <td>2. Circuit Breakers</td> <td>Failed open, Failed closed</td> </tr> <tr> <td>3. Coils</td> <td>Open winding</td> </tr> <tr> <td>4. Connectors</td> <td>Shorts (pin-to-pin) Shorts (pin-to-chassis) Opens, pin</td> </tr> <tr> <td>5. Diodes</td> <td>Short circuits, Open circuits</td> </tr> <tr> <td>6. Microcircuits (outputs only)</td> <td>Saturated High, Saturated Low, Open (Hi Z output)</td> </tr> <tr> <td>7. Relays-electromechanical</td> <td>Contact permanently closed Contact permanently open Excessive contact bounce</td> </tr> <tr> <td>8. Resistors</td> <td>Open circuit</td> </tr> <tr> <td>9. Switches, rotary</td> <td>High resistance contact, Open / Short</td> </tr> <tr> <td>10. Switches, toggle</td> <td>Permanently open Permanently closed</td> </tr> <tr> <td>11. Transformers</td> <td>Shorted turns, Open turns</td> </tr> <tr> <td>12. Transistors, silicon</td> <td>Shorted CE Shorted CB Open circuit C, B, or E</td> </tr> </tbody> </table> | | <u>1. Part</u> | <u>Failure Mode</u> | 1. Capacitors | Short Circuit Excessive leakage (electrolytic) Open circuit | 2. Circuit Breakers | Failed open, Failed closed | 3. Coils | Open winding | 4. Connectors | Shorts (pin-to-pin) Shorts (pin-to-chassis) Opens, pin | 5. Diodes | Short circuits, Open circuits | 6. Microcircuits (outputs only) | Saturated High, Saturated Low, Open (Hi Z output) | 7. Relays-electromechanical | Contact permanently closed Contact permanently open Excessive contact bounce | 8. Resistors | Open circuit | 9. Switches, rotary | High resistance contact, Open / Short | 10. Switches, toggle | Permanently open Permanently closed | 11. Transformers | Shorted turns, Open turns | 12. Transistors, silicon | Shorted CE Shorted CB Open circuit C, B, or E |
| <u>1. Part</u> | <u>Failure Mode</u> | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1. Capacitors | Short Circuit Excessive leakage (electrolytic) Open circuit | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2. Circuit Breakers | Failed open, Failed closed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3. Coils | Open winding | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4. Connectors | Shorts (pin-to-pin) Shorts (pin-to-chassis) Opens, pin | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5. Diodes | Short circuits, Open circuits | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6. Microcircuits (outputs only) | Saturated High, Saturated Low, Open (Hi Z output) | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7. Relays-electromechanical | Contact permanently closed Contact permanently open Excessive contact bounce | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8. Resistors | Open circuit | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9. Switches, rotary | High resistance contact, Open / Short | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10. Switches, toggle | Permanently open Permanently closed | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11. Transformers | Shorted turns, Open turns | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12. Transistors, silicon | Shorted CE Shorted CB Open circuit C, B, or E | | | | | | | | | | | | | | | | | | | | | | | | | | |

DRD-02

Table 2. Example Failure Modes, Effects, and Analysis Form

Assembly Name _____
 Serial No _____ Schematic _____

Analyst _____ Date _____

| Item | Failure Mode | Most Probable Cause | Failure Effect | Failure Mode Detection | Remarks |
|---------------------|------------------|----------------------------------|--------------------|---------------------------------------|------------------------------------|
| <u>Connector J1</u> | | | | | |
| Pin 1 | Short to Pin 2 | Incorrect connector installation | Loss of signal "X" | Transceiver Circuit "A" does not work | Connector J1 installed incorrectly |
| Pin 2 | Short to Pin 6 | Incorrect connector installation | Loss of signal "Y" | Transceiver Circuit "B" does not work | Connector J1 installed incorrectly |
| Pin 3 | Short to chassis | Incorrect connector installation | Loss of signal "Z" | Transceiver Circuit "C" does not work | Connector J1 installed incorrectly |

DRD-03

DATA REQUIREMENT DESCRIPTION

| | |
|---|--|
| <p>TITLE</p> <p>Mechanical/Electromechanical Fault Tree Analysis (FTA)</p> | <p>NUMBER</p> <p>RA-003 Page 1 of 1</p> |
| <p>USE</p> <p>This analysis shall specify an undesired state of the antenna and then the antenna shall be analyzed in context of its environment and operation to find all credible ways in which the undesired event can occur.</p> | <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> <p>JPL D-5703</p> |

PREPARATION INFORMATION

FTAs shall be performed on all mechanisms and devices. These mechanical FTAs shall address failure modes capable of occurring down to the lowest level piece part.

These analyses shall include an assessment of preventive measures to reduce failure likelihood and alternate modes of operation for mitigating failure effects. The corrective actions may be documented using guidelines in JPL D-5703, or contractor equivalent. The results of these analyses will enable engineering decisions to be made by the cognizant design organization to indicate whether or not additional analysis, testing, inspection, or other steps should be taken to increase the reliability of the flight hardware. These decisions shall be reported at all design reviews subsequent to completing the analysis.

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|---|--|
| <p>TITLE</p> <p>Thermal Stress Analysis</p> | <p>NUMBER</p> <p>RA-004 Page 1 of 1</p> |
| <p>USE</p> <p>The purpose of the Thermal Analysis is, in conjunction with testing, to provide a method for verification of performance requirements. This analysis should be an integral part of the design process.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>(1) Contractors may utilize their own Thermal Analysis guidelines after review and approval by JPL.</p> <p>(2) Contractor defined format is acceptable.</p> <p>Thermal stress analysis shall address the effect of the thermal environment, including worst case estimates, for all anticipated environmental conditions. The analysis shall address material fatigue and the effect of thermal cycling on solder joints, conformal coating, other critical materials, and semiconductor junction temperatures.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|--|--|
| <p>TITLE</p> <p>Structural Stress Analysis</p> | <p>NUMBER</p> <p>RA-005 Page 1 of 2</p> |
| <p>USE</p> <p>The purpose of the Structural Analysis report is to document and present the structural analysis for flight and ground hardware. The analysis should be of sufficient fidelity to ensure that structural verification requirements can be met.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <ol style="list-style-type: none"> 1. Contractors may utilize their own Structural Analysis guidelines after review and approval by JPL. 2. Contractor defined format is acceptable. <p>This report shall demonstrate the structural integrity of the item(s) to be delivered by assessing the size and location of applied loads, load paths and critical failure modes. Analysis of gears and bearings, including loads, sizing lifetime and stresses shall be included. The report should include flight and ground handling loads on flight hardware and stress analysis of deliverable ground handling hardware. The report shall identify all significant frequencies, mode shapes, load conditions, thermal induced loads or stresses, deformations, margins of safety and critical elements. The contractor shall provide the following information as a minimum in Contractor’s format except as noted below:</p> <ol style="list-style-type: none"> 1. Description of the Item <ol style="list-style-type: none"> a. Brief Description b. Overview Picture c. Interface Description and Picture d. Part Numbers for the Item(s) 2. Structural Analysis <ol style="list-style-type: none"> a. Analysis Shall Be In SI Units b. Description of loading cases (liftoff/landing, random vibration, etc.) and their application in the stress analysis (loading diagrams and Identification of load source). c. Description of the stress, gear, bearing or deflection analysis. <p><u>If hand analysis</u> : Include detailed calculations and figures identifying stresses, deflections, critical loads, analysis assumptions, load application points, boundary conditions, material properties, drawing number of part and equation/methodology reference.</p> <p><u>If computer analysis</u>: Include detailed stress, load or deflection contour plots identifying critical locations, critical loads, analysis assumptions, load application points, boundary conditions, material properties, and drawing number of part.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

| | |
|--|---|
| TITLE Structural Stress Analysis | NUMBER RA-005 Page 2 of 2 |
| PREPARATION INFORMATION 3. Normal Modes Analysis a. Include a table of critical frequencies and plots of mode shapes and Modal Mass Fractions For Critical Frequencies. b. Margin of safety table for each critical location. The Margin of safety table should include limit load or stress or deflection, allowable load or stress or deflection, factor of safety, load case, failure mode, material, margin of safety, and drawing number of part 4. Fracture Analysis a. Fracture Critical List. A list identifying the fracture control classification of all parts. b. Load History for each part not subject to proof testing(i.e. load vs. cycles). c. Fracture Log Sheet for each fracture critical part identifying NASAFLAGRO input parameters and results. 5. Safety Analysis A factor of safety analysis shall be performed on mounting feet and attachment hardware only. Structural stress analysis shall be performed on mechanical and electromechanical subsystems/assemblies. The analysis shall address the effects to be experienced by the structure due to the dynamic environment (i.e., acceleration, shock, vibration, and acoustic noise), including worst case estimates for design environmental conditions. The analysis shall also address material fatigue. | |

DRD-01

DATA REQUIREMENT DESCRIPTION

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| TITLE Preliminary Design Report (PDR) | NUMBER RE-001 Page 1 of 1 |
| USE The purpose of the PDR is to ensure that the detailed design and verification requirements are complete and accurate. The PDR is also used to review the design and development approaches that will be used for delivery of the end item to ensure that requirements are implementable and testable | PROGRAM Mars UHF Proximity Antenna (MUPA) |
| INTERRELATIONSHIP | REFERENCES |
| PREPARATION INFORMATION <p>Content: The content of the PDR Data Package will include the following and also shall cover any Inheritance/Lessons Learned related to any FM as applicable.</p> <ol style="list-style-type: none"> 1. Table of Contents 2. Detailed design requirements 3. Requirements verification matrix 4. Design concept, including: <ol style="list-style-type: none"> a. Top level block diagrams, assembly drawings and schematic diagrams b. Lower level drawings and diagrams for critical design areas (to demonstrate feasibility) c. Results of preliminary applicable analyses and trade studies (structural, thermal, electrical, failure modes, disturbance torques, etc.) d. Anticipated nonstandard parts, materials or process usage (with data to support acceptability) 5. Mass Properties Report (mass and center of gravity location) 6. Stowed and deployed volume 7. Structural properties 8. Test concept 9. Operation and usage concept 10. Contamination control provisions and planetary protection measures (if applicable) 11. Schedule, including: <ol style="list-style-type: none"> a. Approach to resolve undefined design or verification requirements b. Long lead parts and materials notification 12. Identification of issues and approach to resolve 13. Results of development testing | |

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DATA REQUIREMENT DESCRIPTION

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| TITLE Parametric Study Report (PSR) | NUMBER RE-002 Page 1 of 1 |
| USE The purpose of the PSR is to present design alternatives that provide higher gain and the associated trade-offs required to obtain the higher gain. The PSR is also used to review the design and development approaches that could be used for delivery of the end item to ensure that requirements are implementable and testable. | PROGRAM Mars UHF Proximity Antenna (MUPA) |
| INTERRELATIONSHIP | REFERENCES |
| PREPARATION INFORMATION <p>Content: The content of the PSR Data Package will include the following and also shall cover any Inheritance/Lessons Learned related to any FM as applicable.</p> <ol style="list-style-type: none"> 1. Table of Contents 2. Detailed design requirements 3. Performance parameter data, including <ol style="list-style-type: none"> a. Mass b. Volume (stowed and deployed) 4. Design concept, including: <ol style="list-style-type: none"> a. Mechanical layout including top level block diagrams b. Results of preliminary applicable analyses and trade studies (structural, thermal, electrical, failure modes, disturbance torques, etc.) c. Anticipated nonstandard parts, materials or process usage (with data to support acceptability) 5. Test concept 6. Operation and usage concept 7. Identification of issues and approach to resolve | |

DRD-01

DATA REQUIREMENT DESCRIPTION

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| <p>TITLE</p> <p>Critical Design Review (CDR)</p> | <p>NUMBER</p> <p>RE-003 Page 1 of 1</p> |
| <p>USE</p> <p>The purpose of the CDR is to ensure that <u>all</u> requirements are complete and accurate, that the proposed design meets those requirements, and to review any design changes. The CDR will be held only when all critical design areas are defined in sufficient detail for fabrication to begin. At the CDR <i>Request For Action (RFA)</i> forms will be used to focus on issue resolution. RFAs require a written response by the contractor describing the action to be taken.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>Format: The format of the CDR Data Package will be defined by the contractor. A viewgraph type presentation is recommended.</p> <p>Content: The content of the CDR Data Package will include the following and also shall cover any Inheritance/Lessons Learned related to any FM as applicable.</p> <ol style="list-style-type: none"> 1. Design and verification requirements (with focus on any changes since PDR) 2. Design concept, including: <ol style="list-style-type: none"> a. Top level block diagrams b. Lower level diagrams for critical design areas (to demonstrate feasibility). c. Results of final applicable analyses (structural, thermal, electrical, failure modes, disturbance torques, etc.) d. Parts, materials or process status including outgassing rate data 3. Mass Properties Report (mass and center of gravity location) 4. Test Plan and performance results 5. Operation and usage concept (with focus on changes since PDR) 6. Schedule, including: <ol style="list-style-type: none"> a. Parts and material receipt b. Fabrication c. Assembly d. Test Readiness Review 7. Identification of issues, required resolution date and responsibility 8. Drawing package including: <ol style="list-style-type: none"> a. Drawing tree b. Indentured parts list and revision status list c. Assembly and subassembly drawing(s) d. Detail Drawing(s) e. Interface Drawing(s) f. Markings g. Thermal Analysis Report h. Structural Analysis Report <p>The contractor shall document the meeting and results of the CDR (including RFAs if any) in a memo and provide those results to JPL within two weeks following the Meeting.</p> | |

DATA REQUIREMENT DESCRIPTION

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| <p>TITLE</p> <p>Thermal Model Data and Documentation</p> | <p>NUMBER</p> <p>TD-001 Page 1 of 1</p> |
| <p>USE</p> <p>Constitutes the thermal mathematical model document requirements.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>Construct a detailed geometric mathematical model (GMM) of the external UHF antenna geometry and a detailed thermal mathematical model (TMM) of the antenna. If internal radiation exchange is significant, construct a detailed internal GMM. The GMMs may be in TRASYS, TSS, TAS, or Thermal Desktop format. The TMMs may be in SINDA/G or SINDA/FIUINT Format. Thermal models shall be based on SI units.</p> <p>Provide reduced models with a maximum of fifty (50) surfaces for the geometric model and one hundred (100) nodes for the thermal model. The reduced model shall be correlatable to within 3C of the detailed thermal model.</p> <p>Provide documentation of the thermal and geometric models, including:</p> <ol style="list-style-type: none"> 1. Nodal breakdown and numbering, including description and diagrams. 2. List of assumptions, boundary conditions, and interface temperatures. 3. Description of operating modes, associated electronics power, heater dissipation and environmental heating as appropriate. 4. List of materials and thermophysical properties versus temperature (as appropriate). (density, specific heat, conductivity, emittance, solar absorptance). 5. Case runs with input and output described. 6. If available provide correlation with thermal test results. The detailed model shall be correlatable to within 3C of the thermal test results. <p>For non-software generated thermal parameters provide:</p> <ol style="list-style-type: none"> 7. Calculation of nodal capacitance values and the properties used. 8. Calculation of linear conductor values and properties used. 9. Calculation of radiative conductor values and the properties used. <p>The Contractor's existing Thermal Modeling approaches/plan, tailored to the MTO Project, may be submitted for JPL Thermal Modeling assessment for adequacy in meeting the intent of this document. The document(s) submitted by the Contractor will be reviewed by JPL, and upon approval, will become the applicable documents for the Contract.</p> | |

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DATA REQUIREMENT DESCRIPTION

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| <p>TITLE</p> <p>Dynamic Model Data and Documentation</p> | <p>NUMBER</p> <p>TD-002 Page 1 of 1</p> |
| <p>USE</p> <p>To assess stiffness of the MUPA to support the MUPA coupled loads analysis, and to verify the MUPA loads.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> <p>DRDs: RA-005</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>The mathematical model of the MUPA may take on different levels of complexity. The structural model of RA-005 may be condensed to an appropriate size consistent with the first fundamental frequency. A relatively higher fundamental (> approximately TBD Hz.) may require only the rigid mass properties, or if a lower frequency, the model may take on one of the below forms.</p> <p>(1) A discrete model with associated mass and stiffness matrices OR (2) A constrained normal modes model with modal mass and stiffness and the appropriate transformation matrices to recover internal responses.</p> <p>Required model information such as specific format, degree of freedom requirements, and other necessary information will need to be supplied.</p> <p>This model can either be transmitted by FTP TBD transfer or by providing a compatible magnetic media that can be read by the MUPA services provider.</p> <p>These data shall be in S. I. Units and shall be updated throughout the design cycle.</p> <p>The MUPA math model submitted for the final Verifications Loads Cycle (VLC) TBD, this model is expected to have been verified by the results of the MUPA dynamic testing.</p> <p>The Contractor's existing Dynamic Modeling approaches/plan, tailored to the MTO Project, may be submitted for JPL Dynamic Modeling assessment for adequacy in meeting the intent of this document. The document(s) submitted by the Contractor will be reviewed by JPL, and upon approval, will become the applicable documents for the Contract.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

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| <p>TITLE</p> <p>Test Procedures</p> | <p>NUMBER</p> <p>TE-001 Page 1 of 1</p> |
| <p>USE</p> <p>This package is to completely document the acceptance and testing procedures.</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>The content of the Acceptance and Test Reports will include the following information:</p> <ol style="list-style-type: none"> 1. Title 2. Contents 3. Administrative Data 4. Revision Records 5. Scope 6. Pretest Requirements (Requirements) 7. Test Setup 8. Test Method 9. Data Requirements 10. Failure Criteria 11. Test Equipment List 12. Data Sheets 13. Safety Requirements 14. Functional and Performance Test Procedures | |

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DATA REQUIREMENT DESCRIPTION

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| <p>TITLE Requirement Verification and Test Plan</p> | <p>NUMBER TE-002 Page 1 of 2</p> |
| <p>USE Describes the Contractor's approach for Verification and Test</p> | <p>PROGRAM Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>Prepare and submit a Verification Plan that defines the list of the requirements, approach and methods the Contractor will implement to verify that the MUPA meets the requirements in Exhibit I. The plan must describe how functional, performance and reliability requirements will be verified at all levels as well as a function of design and implementation maturity (breadboards, engineering models and flight hardware).</p> <p>Where verification and test information required herein are provided in separate and prior delivered CDRL(s), the applicable sections may be referenced and supplemented herein as appropriate.</p> <p>The plan requires the following as a minimum:</p> <ol style="list-style-type: none"> (1) Verification matrix of Contractor-generated requirements with traceability from Exhibit I to all contract specifications (partitioned from subsystems, assemblies, interfaces, etc) identifying verification methods for each requirement. (2) Detailed flow chart(s) of all planned test verification activities from sub-assembly to assembly level, and including test interrelationships, functional verification, dynamic and environmental test (EM only), inspections, analyses, and other activities planned by the Contractor and subcontractors to verify compliance with all requirements. (3) For requirements that will not be verified by test or calibration on the antenna (such as fault protection, margin testing, etc), describe the methods by which these requirements will be validated. Where testbeds, analyses, engineering model hardware will be utilized, provide a description of what will be done to validate that such approaches provide a suitable representation of the flight system as the work evolves over the life of the contract. | |

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DATA REQUIREMENT DESCRIPTION

| TITLE | NUMBER |
|---|-------------------------------------|
| Requirement Verification and Test Plan | TE-002 Page 2 of 2 |
| <p>PREPARATION INFORMATION</p> <p>(4) The plan requires descriptions of the following:</p> <ul style="list-style-type: none">a. Description of all hardware and configurations during verification activitiesb. Test levels and durations (as applicable)c. Pass/Fail criteria for all verification activitiesd. Method of testing, facilities (including location), instrumentation and controls usede. Test data and analysis methodologyf. Plans and approach for development measurement uncertainties for verification test (as applicable)g. Contractor’s plans for Test Readiness Reviews and/or post-test result reviewsh. Safety issues and concerns <p>(5) The plan must specify the applicability of all verification activities to engineering model, structure/thermal model, protoflight hardware, spares, testbeds and all support equipment and ground handling fixture deliverables.</p> <p>(6) Where analyses verify requirements, the plan must specify the analysis methodology, verification procedures, and uncertainties. Also, the plan must specify the source and method of collection and verification of data supplied to the analyses.</p> <p>(7) Identify all parameters requiring calibration. Include required calibration uncertainties and methodology and plan for establishing and verifying calibration errors.</p> <p>(8) Where appropriate, the plan specifies the relationships, interdependencies and planned calibration activities.</p> | |

DRD-01

DATA REQUIREMENT DESCRIPTION

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| <p>TITLE</p> <p>Environmental Test Plan</p> | <p>NUMBER</p> <p>TE-003 Page 1 of 1</p> |
| <p>USE</p> <p>To document the planned methodology for performing subsystem level environmental tests</p> | <p>PROGRAM</p> <p>Mars UHF Proximity Antenna (MUPA)</p> |
| <p>INTERRELATIONSHIP</p> | <p>REFERENCES</p> |
| <p>PREPARATION INFORMATION</p> <p>Environmental test plans for the following environmental tests are to be prepared that describe the details of the proposed system level tests IAW exhibits I/II/.</p> <ol style="list-style-type: none"> 1) Dynamics Tests: Random Vibration, Mechanical Shock 2) Thermal Tests: Thermal vacuum and Temperature tests 3) Electromagnetic Compatibility Tests | |

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