

## SCHEDULE AND TIMELINE

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Last Changed 1999-Apr-21

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### Revision History:

*11 November 1998:* Complete update from baseline WBS plan. Links to internal NRAO web pages with plan details added. This version supersedes all previous versions. R. Simon.

*15 November 1998:* Typographic corrections, add notice that HTML version does not have all tables.

*1999-Feb-12:* Complete update of project milestones and schedule, to reflect progress to date and rescheduled tasks. (R. Simon)

*1999-Mar-02:* Update links (now available to all), editorial changes. (R. Simon)

*1999-Apr-21:* Update milestones and schedule. (R. Simon)

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## Introduction

This chapter outlines the schedule and project planning for the Millimeter Array Project. There are two key aspects of planning for the MMA:

- Tasks and milestones which must be accomplished
- Associated target dates.

The logical structure for the project is built around the concept of a "Work Breakdown Structure", or WBS. The WBS is simply an outline plan of all the work to be accomplished, and provides a framework for scheduling, costing, and tracking progress. Once a baseline WBS has been created, the inevitable changes and unexpected developments any real world project experiences may be incorporated into the WBS, and the impact of problems or unexpected difficulties can be allowed for.

There are three principle tables maintained in this chapter, and updated as necessary:

- A summary table of project milestones and target dates.
- The top most level of the WBS Dictionary, which defines the general task areas for the project.
- The Project WBS, expanded to level 2, presented in the form of a Gantt chart.

The overall form of the WBS for the MMA Project has been agreed upon. The tables in this chapter are a snapshot condensed from the detailed project plan. All tasks and milestones are tied to the WBS.

**Note:** For practical reasons, the HTML version of this chapter does not include detailed tables listed below, other than as links to the relevant PDF files. Readers are *strongly* encouraged to access the [PDF version](#) of this chapter.

### **Table 1: [MMA Design and Development Phase Milestones](#)**

This table lists all scheduled milestones, sorted chronologically within each top level task.

### **Table 2: [MMA Level 1 Tasks](#)**

This table lists all top level tasks from the project WBS, and includes the brief WBS Dictionary entries for each task, where available (some of the Level 1 tasks are described only at level 2 and lower in the WBS).

### **Table 3: [MMA Task Scheduling](#)**

This Table presents a timeline for the project in the form of a Gantt chart, listing all tasks from level 1 or level 2 in the WBS.

Substantially more detailed views of the WBS Gantt Chart and Dictionary are maintained at the following locations in PDF format (the Project Milestones are included for completeness):

- [MMA Project WBS Dictionary](#) (<http://www.cv.nrao.edu/mmaplan/mmadiect.pdf>)
- [MMA Project Gantt Chart](#) (<http://www.cv.nrao.edu/mmaplan/mmagantt.pdf>)
- [MMA Project Milestones](#) (<http://www.cv.nrao.edu/mmaplan/mmamlstn.pdf>)

## MMA Design & Development Phase Milestones

WBS Milestone tasks, sorted by WBS and date

| WBS (f)   | Milestone / Deliverable                       | Baseline   | Current    | Actual     | Responsible          |
|-----------|---|------------|------------|------------|----------------------|
| <b>1</b>  | <b><u>Administration</u></b>                  |            |            |            | <b><u>Brown</u></b>  |
| 1.1.1.10  | Project Book: Version 1                       | 1998-07-20 | 1998-07-20 | 1998-07-20 | Emerson              |
| 1.1.4.10  | Deliver WBS for D&D phase                     | 1998-09-30 | 1998-10-16 | 1998-10-16 | Brown                |
| 1.1.1.20  | Draft Interface Standards                     | 1998-10-30 | 1998-11-09 | 1998-11-09 | Emerson              |
| 1.1.6.10  | Deliver Management Plan for D&D               | 1999-01-29 | 1998-11-30 | 1998-11-30 | Brown                |
| 1.1.3.10  | Complete Draft of Business Procedures         | 1998-10-30 | 1998-12-04 | 1998-12-04 | Porter               |
| 1.1.1.35  | Schedule of Reviews                           | 1999-01-29 | 1999-02-09 | 1999-02-09 | Brown                |
| 1.1.2.15  | Schedule of Meetings                          | 1999-01-29 | 1999-02-09 | 1999-02-09 | Wootten              |
| 1.1.5.10  | Deliver Personnel, Safety & Health Procedures | 1999-01-29 | 1999-03-01 | 1999-03-01 | Brown                |
| 1.1.4.15  | Deliver preliminary WBS Entire Project        | 1999-01-29 | 1999-03-26 | 1999-03-26 | Brown                |
| 1.1.4.35  | Complete prelim cost estimate                 | 1998-12-31 | 1999-04-30 | NA         | Brown                |
| 1.1.4.40  | Deliver Prelim Cost Estimate                  | 1999-04-30 | 1999-04-30 | NA         | Brown                |
| 1.1.3.15  | Deliver Business Procedures for D&D           | 1999-04-30 | 1999-06-01 | NA         | Porter               |
| 1.4.4     | Partnership Recommendations to NSF            | 1999-06-30 | 1999-06-30 | NA         | Brown                |
| 1.3.2     | CONICYT Use Permissions                       | 1999-09-30 | 1999-09-30 | NA         | Hardy                |
| 1.3.3.15  | Access to OSF Land                            | 1999-06-30 | 1999-12-27 | NA         | Hardy                |
| 1.1.6.15  | Deliver Management Plan for Construction      | 1999-09-30 | 2000-01-02 | NA         | Brown                |
| 1.1.1.25  | Interface Standards                           | 2000-01-31 | 2000-01-31 | NA         | Emerson              |
| 1.1.4.20  | Deliver final WBS entire project              | 2000-01-31 | 2000-01-31 | NA         | Brown                |
| <b>2</b>  | <b><u>Site Development</u></b>                |            |            |            | <b><u>Gordon</u></b> |
| 2.1.4     | Deliver Development Plan, v. 1                | 1998-12-15 | 1999-01-15 | 1999-01-15 | Gordon               |
| 2.2.4     | Deliver revised development Plan              | 2000-06-30 | 2000-06-30 | NA         | Gordon               |
| 2.5       | Start Facilities Construction in Chile        | 2001-01-01 | 2001-01-01 | NA         | Gordon               |
| 2.15.2    | Hire Construction Manager for Chile           | 2001-03-01 | 2001-03-01 | NA         | Gordon               |
| 2.20.5.3  | Bid Civil Works Construction                  | 2001-12-03 | 2001-12-03 | NA         | Gordon               |
| 2.25.5.3  | Bid Civil Works Construction                  | 2001-12-03 | 2001-12-03 | NA         | Gordon               |
| 2.30.5.3  | Bid OSF/Array Link Construction               | 2001-12-03 | 2001-12-03 | NA         | Gordon               |
| 2.20.10.3 | Award Array Site Contracts                    | 2002-03-01 | 2002-03-01 | NA         | Gordon               |
| 2.25.10.3 | Award Contracts                               | 2002-03-01 | 2002-03-01 | NA         | Gordon               |
| 2.30.10.3 | Award Contracts                               | 2002-03-01 | 2002-03-01 | NA         | Gordon               |
| 2.30.15.3 | Accept OSF/Array Link                         | 2002-12-13 | 2002-12-13 | NA         | Gordon               |
| 2.20.15.3 | Accept Site Facility                          | 2004-03-15 | 2004-03-15 | NA         | Gordon               |
| 2.25.15.3 | Accept OSF Facility                           | 2004-03-15 | 2004-03-15 | NA         | Gordon               |
|           | <b><u>Antenna</u></b>                         |            |            |            | <b><u>Napier</u></b> |
| 3.2.2     | PDR: Antenna                                  | 1998-07-28 | 1998-07-28 | 1998-07-28 | Napier               |
| 3.3.5     | Vendor Information Meeting                    | 1998-09-23 | 1998-09-23 | 1998-09-23 | Napier               |
| 3.2.4     | CDR: Antenna RFP                              | 1998-11-30 | 1999-03-05 | 1999-03-05 | Napier               |
| 3.3.15    | Issue Prototype Antenna RFP                   | 1999-01-29 | 1999-04-06 | 1999-04-06 | Napier               |
| 3.3.17    | Antenna Bidders Meeting                       | 1999-03-05 | 1999-05-18 | NA         | Napier               |
| 3.3.20    | Receive Prototype Antenna Bid Response        | 1999-04-30 | 1999-06-30 | NA         | Napier               |
| 3.3.30    | Sign Contract (#1+Option #2)                  | 1999-06-30 | 1999-10-01 | NA         | Napier               |
| 3.3.35.05 | Prototype Antenna PDR                         | 2000-02-15 | 2000-02-15 | NA         | Napier               |
| 3.6.2     | PDR: Antenna Metrology                        | 2000-05-24 | 2000-03-01 | NA         | Napier               |

## MMA Design & Development Phase Milestones

WBS Milestone tasks, sorted by WBS and date

| WBS (f)     | Milestone / Deliverable                         | Baseline   | Current    | Actual     | Responsible    |
|-------------|---|------------|------------|------------|----------------|
| 3.5.30      | CDR: Antenna Apex                               | 1999-10-29 | 2000-03-14 | NA         | Napier         |
| 3.8.2       | Deliver Transporter Requirements                | 2000-03-31 | 2000-03-16 | NA         | Napier         |
| 3.8.4       | Issue Transporter RFP                           | 2000-06-30 | 2000-06-04 | NA         | Napier         |
| 3.3.35.10   | Prototype Antenna CDR                           | 2000-07-03 | 2000-07-03 | NA         | Napier         |
| 3.3.35.15   | Prot Antenna Complete Design Doc                | 2000-10-02 | 2000-10-02 | NA         | Napier         |
| 3.3.35.20   | Prot Antenna Final Design Approval              | 2000-11-01 | 2000-11-01 | NA         | Napier         |
| 3.8.10      | Sign Transporter Contract                       | 2001-01-26 | 2000-12-24 | NA         | Napier         |
| 3.6.40      | CDR: Antenna Metrology                          | 2001-02-14 | 2001-01-28 | NA         | Napier         |
| 3.5.40      | Deliver Prototype Antenna Apex                  | 2001-01-31 | 2001-01-31 | NA         | Napier         |
| 3.3.35.25   | Prot Antenna Fabrication Complete               | 2001-04-02 | 2001-04-02 | NA         | Napier         |
| 3.3.35.30   | Prot Antenna Assembly Complete                  | 2001-04-30 | 2001-04-30 | NA         | Napier         |
| 3.6.12      | Deliver Prototype Antenna Metrology             | 2001-05-17 | 2001-05-17 | NA         | Napier         |
| 3.3.45      | Delivery of Antenna #1                          | 2001-06-01 | 2001-06-01 | NA         | Napier         |
| 3.8.20      | Deliver/Accept Transporter #1                   | 2001-06-01 | 2001-06-01 | NA         | Napier         |
| <b>4</b>    | <b>Receivers</b>                                |            |            |            | <b>Emerson</b> |
| 4.1.12.7    | Complete 86 GHz vacuum window prototype         | 1998-11-20 | 1998-11-20 | 1998-11-20 | Webber         |
| 4.1.6.10    | Complete 230 LO Plate, sideband source plates   | 1999-02-19 | 1998-12-01 | 1998-12-01 | Webber         |
| 4.1.8.1.10  | Comp. Eval. 200-300 GHz bal & sb-sep prototypes | 1999-01-22 | 1999-03-08 | 1999-03-08 | Webber         |
| 4.2.7       | Deliver Test Ant Amplifier: 30 GHz Band         | 1999-06-29 | 1999-06-29 | NA         | Webber         |
| 4.1.18.5    | Deliver Test Ant mixer: 86 GHz band             | 1999-06-30 | 1999-06-30 | NA         | Webber         |
| 4.1.1.2     | PDR: SIS Mixer                                  | 1999-01-29 | 1999-09-15 | NA         | Webber         |
| 4.1.12.10   | Complete 86 GHz Vac. Window Development         | 1999-04-23 | 1999-09-20 | NA         | Webber         |
| 4.1.18.3    | Deliver Test Ant mixer: 230 GHz band            | 1999-06-30 | 1999-09-30 | NA         | Webber         |
| 4.2.9       | Deliver Test Ant Amplifier: 90 GHz Band         | 1999-09-30 | 1999-09-30 | NA         | Webber         |
| 4.3.5       | Complete Eval. Rcvr. Interface agreements       | 1999-05-31 | 1999-10-01 | NA         | Emerson        |
| 4.3.10      | CDR: Evaluation Receiver                        | 1999-11-29 | 1999-11-29 | NA         | Emerson        |
| 4.1.4.7     | Complete Cryogenic IF plates for mixer testing  | 1999-06-01 | 1999-11-29 | NA         | Webber         |
| 4.1.11.2.10 | First MMIC IF Amplifier Tests                   | 1999-04-09 | 1999-11-30 | NA         | Webber         |
| 4.1.10.10   | Complete Wafer Evaluation circuits              | 1999-08-13 | 1999-12-01 | NA         | Webber         |
| 4.1.9.10    | Complete automated mixer testing                | 1999-12-03 | 1999-12-03 | NA         | Webber         |
| 4.1.6.11    | Complete 650 LO plate                           | 1999-10-22 | 1999-12-12 | NA         | Webber         |
| 4.1.8.3.1.9 | Start 650 building block mixer tests            | 1999-10-22 | 1999-12-20 | NA         | Webber         |
| 4.2.8       | Deliver Prototype Amplifier: 30 GHz Band        | 2000-01-31 | 2000-01-31 | NA         | Webber         |
| 4.1.11.2.14 | Complete integrated MMIC IF development         | 1999-10-01 | 2000-02-28 | NA         | Webber         |
| 4.4.4       | PDR: MMA Receiver                               | 1999-09-24 | 2000-03-31 | NA         | Emerson        |
| 4.1.11.4.4  | Complete IF development                         | 2000-03-01 | 2000-04-17 | NA         | Webber         |
| 4.1.8.2.3.9 | 230 balanced mixer tests                        | 1999-11-08 | 2000-05-02 | NA         | Webber         |
| 4.1.13.15   | Complete Fourier Transform Spectrometer         | 2000-03-03 | 2000-05-03 | NA         | Webber         |
| 4.1.1.5     | CDR: SIS Mixer                                  | 1999-09-30 | 2000-07-07 | NA         | Webber         |
| 4.1.8.3.2.9 | Start 650 SSB Mixer tests                       | 2000-04-21 | 2000-09-25 | NA         | Webber         |
| 4.1.8.3.3.9 | Start 650 balanced mixer tests                  | 2000-04-21 | 2000-09-25 | NA         | Webber         |
| 4.1.8.2.4.9 | 230 bal., sideband-sep. mixer tests             | 2000-05-08 | 2000-12-05 | NA         | Webber         |
| 4.4.35      | CDR: MMA Receiver System                        | 2000-07-05 | 2000-12-29 | NA         | Emerson        |

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WBS Milestone tasks, sorted by WBS and date

| WBS (f)     | Milestone / Deliverable                           | Baseline   | Current    | Actual     | Responsible           |
|-------------|---|------------|------------|------------|-----------------------|
| 4.10.10     | PDR: Cryogenics Development                       | 2000-07-05 | 2000-12-29 | NA         | Emerson               |
| 4.1.8.2.10  | Deliver prototype 230 GHz                         | 2000-07-03 | 2001-02-06 | NA         | Webber                |
| 4.10.15     | CDR: Cryogenics Development                       | 2001-03-30 | 2001-03-30 | NA         | Emerson               |
| 4.3.20      | Deliver Antenna Test Eval Receiver                | 2001-05-01 | 2001-05-01 | NA         | Emerson               |
| 4.4.30.4    | Deliver Prototype Dewar                           | 2001-01-31 | 2001-07-27 | NA         | Emerson               |
| 4.1.8.3.4.9 | Start 650 Bal. sb. sep. mixer tests               | 2001-04-20 | 2001-09-24 | NA         | Webber                |
| 4.10.20     | Deliver Prototype Cryogenics System               | 2001-11-30 | 2001-11-30 | NA         | Emerson               |
| 4.1.8.3.5   | Deliver prototype 650 GHz                         | 2001-11-02 | 2002-04-08 | NA         | Webber                |
| 4.4.50      | Complete Prototype MMA Receiver                   | 2002-03-29 | 2002-05-24 | NA         | Emerson               |
| 4.4.65      | Release MMA Receiver for manufacture              | 2002-10-25 | 2002-12-20 | NA         | Emerson               |
| <b>5</b>    | <b><u>LO System</u></b>                           |            |            |            | <b><u>Emerson</u></b> |
| 5.3.4       | PDR: Multiplier Chain LO                          | 1998-11-16 | 1999-02-19 | 1999-02-19 | Webber                |
| 5.4.2.2     | Optical R/T Phase Lab Demo                        | 1999-02-26 | 1999-03-29 | 1999-03-29 | Emerson               |
| 5.4.1.3     | Photonic Phase Cal Feasibility Demo               | 1998-12-31 | 1999-04-15 | 1999-04-15 | Emerson               |
| 5.4.2.4     | PDR: Optical R/T phase meas.                      | 1999-04-30 | 1999-06-30 | NA         | Emerson               |
| 5.2.3       | PDR: LO Reference                                 | 1999-06-30 | 1999-06-30 | NA         | Sramek                |
| 5.4.1.5     | PDR: Photonic Phase Cal System                    | 1999-05-31 | 1999-06-30 | NA         | Emerson               |
| 5.4.5       | PDR: Photonic LO                                  | 1999-06-30 | 1999-06-30 | NA         | Emerson               |
| 5.3.3.3.9   | Deliver 230 GHz Doubler Power Demo                | 1998-12-31 | 1999-07-01 | NA         | Webber                |
| 5.4.6.6     | Deliver 100 GHz Velocity Matched photomixer       | 1999-10-29 | 1999-10-29 | NA         | Emerson               |
| 5.3.6.4     | Deliver Prototype 230 GHz LO for Prot. Rcvr.      | 1999-12-27 | 1999-12-27 | NA         | Webber                |
| 5.4.1.7     | CDR: Photonic Phase Cal System                    | 1999-12-31 | 1999-12-31 | NA         | Emerson               |
| 5.4.2.8     | CDR: Optical R/T Phase Measurement                | 1999-12-31 | 1999-12-31 | NA         | Emerson               |
| 5.4.2.9     | Decision: Opt or Microwave R/T Phase Meas for MMA | 2000-01-30 | 2000-01-30 | NA         | Sramek                |
| 5.3.5.10    | Deliver 230 GHz MC LO for Eval Rcvr               | 2000-03-01 | 2000-03-01 | NA         | Webber                |
| 5.4.10      | CDR: Photonic LO                                  | 2000-03-31 | 2000-03-31 | NA         | Emerson               |
| 5.5         | CDR: LO System                                    | 2000-06-30 | 2000-06-30 | NA         | Emerson               |
| 5.6         | Decision: Multiplier Chain or Photonic LO         | 2000-06-30 | 2000-06-30 | NA         | Emerson               |
| 5.3.3.8     | CDR: Multiplier Chain LO                          | 2000-03-31 | 2000-12-01 | NA         | Webber                |
| 5.4.1.9     | Deliver Photonic Phase Cal prototypes             | 2000-12-31 | 2000-12-31 | NA         | Emerson               |
| 5.2.35      | Deliver LO Reference bench prototype              | 2001-01-31 | 2001-01-31 | NA         | Sramek                |
| 5.2.40      | Deliver LO Ref Field Prototypes                   | 2002-03-01 | 2002-03-01 | NA         | Sramek                |
| 5.4.13      | Deliver Prototype Photonic LO                     | 2002-08-23 | 2002-08-23 | NA         | Emerson               |
| 5.8         | Production Review: LO                             | 2003-02-28 | 2003-02-28 | NA         | Emerson               |
| 5.4.1.11    | Production Review: Photonic Phase Cal             | 2003-05-05 | 2003-03-03 | NA         | Emerson               |
| <b>6</b>    | <b><u>IF System</u></b>                           |            |            |            | <b><u>Sramek</u></b>  |
| 6.3         | PDR: IF System                                    | 1999-04-30 | 1999-05-17 | NA         | Sramek                |
| 6.10        | CDR: IF System                                    | 2000-03-31 | 2000-03-31 | NA         | Sramek                |
| 6.15        | Deliver (Bench) Prototype IF System               | 2001-01-31 | 2001-01-31 | NA         | Sramek                |
| 6.20        | Deliver IF Field Prototypes to Test Interfeometer | 2002-03-01 | 2002-03-01 | NA         | Sramek                |
| <b>7</b>    | <b><u>FO System</u></b>                           |            |            |            | <b><u>Sramek</u></b>  |
| 7.3         | PDR: FO System (IF Transmission)                  | 1999-05-14 | 1999-05-17 | NA         | Sramek                |
| 7.6.6       | PDR: FO System (LO Transmission)                  | 1999-06-30 | 1999-06-30 | NA         | Sramek                |

## MMA Design & Development Phase Milestones

WBS Milestone tasks, sorted by WBS and date

| WBS (f)   | Milestone / Deliverable                            | Baseline   | Current    | Actual     | Responsible               |
|-----------|--|------------|------------|------------|---------------------------|
| 7.13      | Decision: Analog/Digital Transmission              | 1999-07-30 | 1999-10-29 | NA         | Sramek                    |
| 7.10      | CDR: FO System                                     | 2000-03-31 | 2000-03-31 | NA         | Sramek                    |
| 7.12      | Deliver Bench Prototype FO System                  | 2001-01-31 | 2001-01-31 | NA         | Sramek                    |
| 7.20      | Deliver FO Field Prototypes to Test Interferometer | 2002-03-01 | 2002-03-01 | NA         | Sramek                    |
| <b>8</b>  | <b><u>Correlator</u></b>                           |            |            |            | <b><u>Webber</u></b>      |
| 8.5.3.3   | Decision: FIR Filter or Analog BBC                 | 1998-12-31 | 1999-02-18 | 1999-02-18 | Webber                    |
| 8.3.5     | PDR: Correlator                                    | 1999-08-02 | 1999-08-02 | NA         | Webber                    |
| 8.5.8     | CDR: Finite Impulse Response Filter                | 1999-07-01 | 2000-02-28 | NA         | Webber                    |
| 8.2.6     | Deliver Test Correlator to VLA site                | 2000-03-31 | 2000-03-31 | NA         | Webber                    |
| 8.10      | CDR: Prototype Correlator                          | 2000-07-31 | 2000-07-31 | NA         | Webber                    |
| 8.5.16    | Deliver FIR Filter for Test Interferometer         | 2000-12-01 | 2000-12-01 | NA         | Webber                    |
| 8.12.5    | Deliver Prototype Correlator to VLA site           | 2003-05-30 | 2003-05-30 | NA         | Webber                    |
| 8.13.1.5  | Deliver 1/4 Correlator to MMA site                 | 2004-06-18 | 2004-06-18 | NA         | Webber                    |
| 8.13.2.4  | Deliver 1/4 Correlator to MMA site                 | 2005-03-25 | 2005-03-25 | NA         | Webber                    |
| 8.13.3.4  | Deliver 1/4 Correlator to MMA site                 | 2005-12-30 | 2005-12-30 | NA         | Webber                    |
| 8.13.4.4  | Deliver 1/4 Correlator to MMA site                 | 2006-10-06 | 2006-10-06 | NA         | Webber                    |
| <b>9</b>  | <b><u>Computing</u></b>                            |            |            |            | <b><u>Glendenning</u></b> |
| 9.4.4     | Deliver: M&C Draft Interface specifications        | 1999-06-01 | 1999-06-01 | NA         | Glendenning               |
| 9.2       | PDR: Comp. Requirements & Control Software         | 1999-06-30 | 1999-06-30 | NA         | Glendenning               |
| 9.7.4     | CDR: Test Correlator Software                      | 1999-09-01 | 1999-10-31 | NA         | Glendenning               |
| 9.4.8     | CDR: Monitor & Control System                      | 2000-03-31 | 2000-01-30 | NA         | Glendenning               |
| 9.5.7     | CDR: Single Dish Antenna Test System               | 2000-03-01 | 2000-03-01 | NA         | Glendenning               |
| 9.4.10    | M&C Board available                                | 2000-03-31 | 2000-03-31 | NA         | Emerson                   |
| 9.7.7     | Deliver Test Correlator Software                   | 2000-03-01 | 2000-05-28 | NA         | Glendenning               |
| 9.13.3    | CDR: Archiving                                     | 2000-05-29 | 2000-05-29 | NA         | Glendenning               |
| 9.5.11    | Deliver Single Dish Antenna Test System            | 2001-03-01 | 2001-03-01 | NA         | Glendenning               |
| 9.4.13    | Deliver: M&C System                                | 2001-03-30 | 2001-03-30 | NA         | Glendenning               |
| 9.6.1.4   | Deliver Holography System Software                 | 2001-03-30 | 2001-03-30 | NA         | Emerson                   |
| 9.14.3    | CDR: Real-time Imaging                             | 2001-07-24 | 2001-07-24 | NA         | Glendenning               |
| 9.15.3    | CDR: Scheduling                                    | 2000-12-28 | 2003-12-01 | NA         | Glendenning               |
| <b>10</b> | <b><u>System Integration</u></b>                   |            |            |            | <b><u>Emerson</u></b>     |
| 10.7.3    | Design Review: Holography System                   | 1999-03-29 | 1999-04-19 | 1999-04-19 | Emerson                   |
| 10.2.3    | Deliver MMA Interfaces and Standards Document      | 1999-04-30 | 1999-06-30 | NA         | Emerson                   |
| 10.10.2   | Deliver Prot. Ant. Testing Plan                    | 1999-07-02 | 1999-07-02 | NA         | Emerson                   |
| 10.4.2    | Design Review: Test Int. Site Preparation          | 2000-04-03 | 2000-04-03 | NA         | Sramek                    |
| 10.7.6    | Deliver Holography System                          | 2000-06-30 | 2001-03-30 | NA         | Emerson                   |
| 10.4.7    | Test Interferometer Site Complete                  | 2001-04-30 | 2001-04-30 | NA         | Sramek                    |
| 10.10.4.4 | Antenna #1 Outfitting Complete                     | 2001-11-02 | 2001-09-03 | NA         | Emerson                   |
| 10.10.9.4 | Antenna #2 Outfitting Complete                     | 2002-05-31 | 2002-04-01 | NA         | Emerson                   |
| <b>11</b> | <b><u>Calibration &amp; Imaging</u></b>            |            |            |            | <b><u>Wootten</u></b>     |
| 11.1.6.1  | Site Char. & Monitoring Review (URSI meeting)      | 1999-01-11 | 1999-01-11 | 1999-01-11 | Radford                   |
| 11.3.3.4  | Initial Amplitude Cal Review                       | 1999-05-31 | 1999-05-31 | NA         | Wootten                   |
| 11.3.2.1  | Initial Radiometric Phase Cal Review               | 1999-05-31 | 1999-06-09 | NA         | Wootten                   |

## MMA Design & Development Phase Milestones

WBS Milestone tasks, sorted by WBS and date

| WBS (f)  | Milestone / Deliverable                 | Baseline   | Current    | Actual | Responsible |
|----------|---|------------|------------|--------|-------------|
| 11.3.2.4 | Decision: 183 or 22 GHz Phase monitor   | 2001-05-31 | 1999-07-01 | NA     | Wootten     |
| 11.2.3   | Design Review: Array Configuration      | 2000-01-31 | 2000-01-31 | NA     | Wootten     |
| 11.1.6.2 | Mid-term Site Char. & Monitoring Review | 2000-03-31 | 2000-03-31 | NA     | Radford     |
| 11.3.2.2 | Mid-term Radiometric Phase Cal Review   | 2000-05-31 | 2000-05-31 | NA     | Wootten     |
| 11.3.3.5 | Mid-term Amplitude Cal Review           | 2000-05-31 | 2000-05-31 | NA     | Wootten     |
| 11.1.6.3 | Final Site Char. & Monitoring Review    | 2001-03-30 | 2001-03-30 | NA     | Radford     |
| 11.3.2.3 | Final Radiometric Phase Cal Review      | 2001-05-31 | 2001-05-31 | NA     | Wootten     |
| 11.3.3.6 | Final Amplitude Cal Review              | 2001-05-31 | 2001-05-31 | NA     | Wootten     |

Report name:

**MMA Level 1 Tasks**

| <b>WBS (f)</b>   | <b>Task</b>   | <b>Start</b>             | <b>Finish</b>            | <b>Duration</b>      | <b>Work</b>             |
|------------------|---|--------------------------|--------------------------|----------------------|-------------------------|
| <b><u>1</u></b>  | <b><u>Administration</u></b>  | <b><u>1998-06-01</u></b> | <b><u>2001-01-01</u></b> | <b><u>135.2w</u></b> | <b><u>603.01w</u></b>   |
|                  | Element Scope: This task includes all the responsibilities for management of the MMA project. Management of the project engineering, business and contracting affairs, personnel, budget and schedule, the WBS, documentation, standards, reporting and archive are all included within this task. In addition it is the responsibility of this task to assure that the MMA project meets its scientific goals.   |                          |                          |                      |                         |
| <b><u>2</u></b>  | <b><u>Site Development</u></b>  | <b><u>1998-06-01</u></b> | <b><u>2007-12-28</u></b> | <b><u>500w</u></b>   | <b><u>137.8w</u></b>    |
|                  | Element Scope: In the initial D&D phase it is the responsibility of the Division Head for Site Development to draft an operating plan for the MMA in Chile. He will do this by establishing the operational requirements and then creating an operational model that meets those requirements. The plan will be developed in consultation with the universities and observatories presently operating facilities in Chile. The plan will be costed. In the construction phase of the project the Division Head will be responsible for construction of the civil works. |                          |                          |                      |                         |
| <b><u>3</u></b>  | <b><u>Antenna</u></b>   | <b><u>1998-06-01</u></b> | <b><u>2002-12-30</u></b> | <b><u>239.2w</u></b> | <b><u>712.46w</u></b>   |
|                  | Element Scope: This element includes all steps required for producing all antennas delivered to site on foundation provided. Setting surface to require accuracy. Making certain all antennas meet design specification. Producing antenna transporters. Will provide mechanical support for interfaces to antenna.   |                          |                          |                      |                         |
| <b><u>4</u></b>  | <b><u>Receivers</u></b>   | <b><u>1998-06-01</u></b> | <b><u>2007-04-27</u></b> | <b><u>465w</u></b>   | <b><u>2,421.29w</u></b> |
| <b><u>5</u></b>  | <b><u>LO System</u></b>   | <b><u>1998-06-01</u></b> | <b><u>2007-03-09</u></b> | <b><u>458w</u></b>   | <b><u>1,099.44w</u></b> |
| <b><u>6</u></b>  | <b><u>IF System</u></b>   | <b><u>1998-11-02</u></b> | <b><u>2002-03-01</u></b> | <b><u>173.8w</u></b> | <b><u>335w</u></b>      |
|                  | The IF system includes 1) at the antenna, the broadband 4 - 12 GHz signal path between the receiver and the fiber optic transmitter and 2) in the Central Electronics Building (CEB), the broadband signal path between the fiber optic receiver and the digital sampler. The interface to the receivers is after the band selection switch and final room temperature amplifiers in the receiver package.  |                          |                          |                      |                         |
|                  | During the D&D phase, a complete IF system design will be done and select modules and sub-modules will be prototyped. The module interfaces and Monitor/Control interfaces will be developed and tested. The goal is to prototype enough of the system so that construction of the test interferometer system can proceed rapidly when the construction phase begins, and deliver a bench prototype system before 12/00.  |                          |                          |                      |                         |
| <b><u>7</u></b>  | <b><u>FO System</u></b>   | <b><u>1999-01-25</u></b> | <b><u>2002-03-01</u></b> | <b><u>161.8w</u></b> | <b><u>407w</u></b>      |
|                  | Fiber Optic System - This element includes the fiber optic transmitter / receiver pairs and all associated M/C and interconnecting FO cabling for relaying the signals of four subsystems: 1) the broadband IF, 2) the LO reference distribution, 3) the round trip phase correction, and 4) the M/C system.  |                          |                          |                      |                         |
|                  | During the D&D phase, the complete fiber optic system design will be done and prototype transmitter/ receiver pairs for each of the four sub-systems (IF, LO ref, round-trip phase, and M/C) will be demonstrated. The module interfaces and Monitor/Control interfaces will be developed and tested. The goal is to prototype enough of the system so that construction of the test interferometer system can proceed rapidly when the construction phase begins. The prototype system will be delivered by 12/00.   |                          |                          |                      |                         |
| <b><u>8</u></b>  | <b><u>Correlator</u></b>  | <b><u>1998-06-01</u></b> | <b><u>2007-03-30</u></b> | <b><u>461w</u></b>   | <b><u>484w</u></b>      |
|                  | The MMA correlator will accept multiple baseband analog signals from the IF system, digitize them, and calculate the cross-correlation functions on a pairwise basis.   |                          |                          |                      |                         |
| <b><u>9</u></b>  | <b><u>Computing</u></b>   | <b><u>1998-10-01</u></b> | <b><u>2006-07-18</u></b> | <b><u>406.8w</u></b> | <b><u>296.5w</u></b>    |
|                  | These activities implement all MMA system software. This includes real-time and near-real-time software to monitor and control hardware devices, software to schedule the array, software to format the data suitably for post-processing, software to archive and restore the data, software to perform fundamental calibrations (e.g. pointing) required to operate the array, commissioning software (e.g. holography), and software to implement a near-real-time image pipeline.   |                          |                          |                      |                         |
|                  | It does not generally include post-processing software, firmware which is "inside" the device (possibly excepting the correlator), or engineering test software which is not needed during operations (i.e., operators would not run it).   |                          |                          |                      |                         |
| <b><u>10</u></b> | <b><u>System Integration</u></b>  | <b><u>1998-06-01</u></b> | <b><u>2003-03-28</u></b> | <b><u>252w</u></b>   | <b><u>621.9w</u></b>    |
| <b><u>11</u></b> | <b><u>Calibration &amp; Imaging</u></b>   | <b><u>1998-06-01</u></b> | <b><u>2001-06-01</u></b> | <b><u>157w</u></b>   | <b><u>565w</u></b>      |
|                  | This covers aspects of characterizing the MMA site at Chajnantor, of designing and optimizing the array configurations, of correcting astronomical observations for atmospheric and instrumental effects, and of understanding the characteristics and quality of the images the MMA will produce.  |                          |                          |                      |                         |









## MMA Task Scheduling

Filter for MMA Tasks (Level 1 and 2) selected

| WBS (f) | Task  | Start             | Finish            | Duration      | Work          | 1998 |   |   |   | 1999 |   |   |   | 2000 |   |   |   | 2001 |   |   |   | 2002 |   |   |   |   |   |   |   |   |   |   |   |
|---------|---|-------------------|-------------------|---------------|---------------|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|------|---|---|---|---|---|---|---|---|---|---|---|
|         |   |                   |                   |               |               | M    | J | J | A | S    | O | N | D | J    | F | M | A | M    | J | J | A | S    | O | N | D | J | F | M | A | M | J | J | A |
| 9.2     | <b>PDR: Comp. Requirements &amp; Control Software</b> | 1999-06-30        | 1999-06-30        | 0d            | 0w            |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.3     | Software Practices and Standards                      | 1998-12-01        | 1999-02-22        | 12w           | 9w            |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.4     | <u>Monitor and Control</u>                            | <u>1998-10-12</u> | <u>2001-03-30</u> | <u>129w</u>   | <u>103.5w</u> |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.5     | <u>Test Antenna Control Software</u>                  | <u>1998-10-23</u> | <u>2001-03-01</u> | <u>123w</u>   | <u>84w</u>    |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.6     | <u>Commissioning Software</u>                         | <u>2000-06-01</u> | <u>2001-03-30</u> | <u>43.4w</u>  | <u>33w</u>    |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.7     | <u>Test Correlator Software</u>                       | <u>1999-02-15</u> | <u>2000-05-28</u> | <u>67w</u>    | <u>40w</u>    |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.8     | Prototype Antenna Software Integration                | 2001-06-01        | 2001-11-29        | 26w           | 0w            |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.9     | Prototype Antenna Software Support                    | 2001-11-30        | 2004-11-25        | 156w          | 0w            |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.10    | Antenna   | 1999-02-01        | 2004-02-27        | 265w          | 0w            |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.11    | Correlator  | 1999-02-01        | 2004-02-27        | 265w          | 0w            |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.12    | Data Production                                       | 2001-06-01        | 2003-05-29        | 104w          | 0w            |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.13    | <u>Archiving</u>                                      | <u>1998-12-01</u> | <u>2005-12-26</u> | <u>369w</u>   | <u>0w</u>     |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.14    | <u>Near real-time imaging</u>                         | <u>1999-12-01</u> | <u>2006-07-18</u> | <u>346w</u>   | <u>0w</u>     |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.15    | <u>Scheduling</u>                                     | <u>1999-01-01</u> | <u>2005-11-25</u> | <u>360.2w</u> | <u>0w</u>     |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 9.16    | <u>Off-Line Data Processing</u>                       | <u>2001-01-01</u> | <u>2001-06-27</u> | <u>25.6w</u>  | <u>12w</u>    |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 10      | <b>System Integration</b>                             | 1998-06-01        | 2003-03-28        | 252w          | 621.9w        |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 10.1    | Overall Specifications for all systems                | 1998-06-01        | 2001-06-01        | 157w          | 31.4w         |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 10.2    | <u>Specification of interfaces and standards</u>      | <u>1998-10-01</u> | <u>2001-05-30</u> | <u>139w</u>   | <u>30w</u>    |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 10.3    | Monitor and Control Coordination                      | 1998-10-05        | 2001-06-01        | 139w          | 13.9w         |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 10.4    | <u>Test Interferometer Site Preparation</u>           | <u>2000-02-01</u> | <u>2001-04-30</u> | <u>65w</u>    | <u>18w</u>    |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 10.7    | <u>Holography System</u>                              | <u>1998-09-01</u> | <u>2001-03-30</u> | <u>134.8w</u> | <u>42w</u>    |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 10.10   | <u>Prototype Antenna Integration and Testing</u>      | <u>1998-06-01</u> | <u>2003-03-28</u> | <u>252w</u>   | <u>486.6w</u> |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 11      | <b>Calibration &amp; Imaging</b>                      | 1998-06-01        | 2001-06-01        | 157w          | 565w          |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 11.1    | <u>Site Characterization and Monitoring</u>           | <u>1998-06-01</u> | <u>2001-06-01</u> | <u>157w</u>   | <u>0w</u>     |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 11.2    | <u>Configuration Studies</u>                          | <u>1998-06-01</u> | <u>2001-06-01</u> | <u>157w</u>   | <u>0w</u>     |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 11.3    | <u>Calibration</u>                                    | <u>1998-06-01</u> | <u>2001-06-01</u> | <u>157w</u>   | <u>0w</u>     |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |
| 11.4    | Imaging studies                                       | 1998-06-01        | 2001-06-01        | 157w          | 0w            |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |      |   |   |   |   |   |   |   |   |   |   |   |

Milestones: **bold type**  
Summary Tasks: underline

Task Split

Progress Milestone

Completed Mlstr Summary

Summary Progress