MILLIMETER ARRAY/ALMA-US
DESIGN AND DEVELOPMENT

MONTHLY REPORT
MONTH END MARCH 2001

1 Executive Summary

The report of the February meeting of the Millimeter Array Oversight Committee (MMAOC) was distributed this period. In the introduction to the report, the committee noted the following:

> The ALMA project is ready to start construction and we recommend that the NSF approve ALMA to move to Phase II. The ALMA team is more than ready for ALMA construction.
>
> The project has made impressive technical progress and is meeting the goals for Phase I.
>
> The NRAO is to be commended for remarkable technical and managerial progress. They have initiated implementation of all of the recommendations we requested at our last meeting, and moved the project from a scientific dream to a realistic plan for an observatory.
>
> NRAO has made rapid progress in all areas, including technical tasks, project management, and also international coordination, and is poised to enter the construction phase of the project. NRAO has shown that they have succeeded admirably in the Design and Development Phase (Phase I).

The MMAOC report can be found at http://www.alma.nrao.edu/docs/mmaoc2001.pdf.

Significant activities this month centered on preparation for the ALMA Coordination Committee meeting to be held early in April in Tokyo. This ACC meeting is expected to be a major step toward a Tripartite ALAM that includes the Japanese. A significant open question is how antennas would be procured among the three partners. To begin exploring this and other similar issues, a series of meetings were held this month between the Japanese Antenna and Systems engineers and the US and European Division Heads and Team Leaders. These were very productive meetings that identified a number of specific issues that will have to be resolved in the coming months.

Progress continues on the US prototype antenna. Vertex is transitioning from design to fabrication. All critical parts are now on order. The design of the CFRP backup structure is nearing completion. Vertex continues to explore options for accelerating the fabrication process to recover the additional time spent on the design phase.

2 Programmatics

2.1 Financial Statement

[Not Included.]

2.2 Personnel

The ALMA Project staffing is reported by WBS Level-1 category based on the joint project WBS. The total number of full-time equivalent employees was 62.3.

2.3 Progress Against Project Milestones

Attached to this report is the Project Gantt chart displaying the summary-level tasks of the Phase 1 Project WBS. The tasks in this view of the project are selected from the complete WBS.

In March, two major milestones were scheduled for completion. These were *Deliver Revised Operations Plan* (WBS 2.07.15) and *Deliver Test Correlator* (WBS 7.10.30).

A draft operations plan was completed in March. This draft will be used to initiate discussions over the next several months on final plans for operations.

The Test Correlator was shipped from Charlottesville to Socorro at the end of February where it will be integrated with modules for the Test Interferometer.

3 Meetings And Memos

3.1 Meetings Held During March 2001

ALMA SSR Meeting - March 1-2
JRDG Teleconference - March 1, March 9, March 19, March 29

ASAC Teleconference - March 14
ALMA US DH Teleconference - March 12, March 19
ALMA Joint DH/TL Teleconference - March 5
AEC Teleconference – March 1, March 8, March 15, March 22, March 29

3.2 Planned Meetings in April 2001

ACC Meeting - April 5/6 - Tokyo, Japan
JRDG Teleconference - April 26
ALMA US DH Teleconference - April 9, April 16, April 23
ALMA Joint DH/TL Teleconference - April 30
AEC Teleconference – April 12, April 19, April 26

3.3 ALMA Technical Memos Distributed in March 2001

352	Design and Development of 183 GHz Water Vapour Radiometers	R. Hills, H. Gibson, et al.
353	Investigation of Suppression of Sidelobes by Simple Displacement of Clustered Groups of Regularly Spaced Antennas	Steven Heddle
354	Choices of Antenna Size and Number for the Atacama Compact Array	Wm. J. Welch
355	Design of the ALMA's Compact Configuration with the Road Design First	L. Kogan
356	Reliability of Nanonics Dualobe Connectors	John Effland
357	Sideband Calibration of Millimeter-Wave Receivers	A.R. Kerr, S.-K. Pan, and J.E. Effland
358	Observing	Melvyn Wright
359	Optics Study for ALMA Receivers	James Lamb

The full catalog of the ALMA Memo Series can be found at the ALMA web site at http://www.alma.nrao.edu/memos/.

4 Technical Progress Reports

4.1 Antennas

Vertex is making good progress with the large mold for fabricating the CFRP reflector backup structure sectors nearing completion and all major components now on order. Tests of various primary reflector anti-solar surface treatments show that sandblasting the

reflector panel surfaces looks best from the point of view of RF loss and solar diffusivity. Still remaining are tests to verify that sandblasting does not degrade the surface profile.

The lightning protection system for the antenna is now designed and the HVAC system for the receiver cabin is advancing. For antenna thermal performance it is necessary that the interior walls of the receiver cabin be precisely temperature controlled, so any heat that is generated in NRAO equipment in the cabin must be confined inside HVAC ducting.

The Antenna group met with representatives from the Japanese Antenna Division concerning the Japanese plans for constructing and testing ALMA antennas if Japan joins ALMA as a full partner. The Japanese want to bring their 12 m prototype antenna to the Test Interferometer site at the VLA in March, 2003, so that it can be tested in the same way as the US and European prototypes. Japan would like the US to provide, using Japanese funding, all of the site infrastructure and electronics equipment needed for the test.

4.2 Front End

Investigated reliability information for Nanonics connectors that are being considered for use in the front-ends. Met with engineers at Ball Aerospace who use these connectors on the SIRTF spacecraft. The results are contained in an ALMA memo.

We have received balanced op amps and programmable potentiometers and will now breadboard an improved mixer bias supply. We have also identified what information should be collected to calculate SIS mixer "yields" and have commenced collecting that data.

Developed procedures to measure sideband-separating receivers that takes into account a finite image rejection and conversion from higher harmonic sidebands. Completed ALMA Memo 357 on the measurement of the sideband ratio in mixer receivers.

Started designing a waveguide-to-suspended stripline transition to allow the present 200-300 GHz SIS mixer substrates to be mounted in a split-block mount. This requires the mixer substrate to be mounted with a different orientation in the waveguide and will make it easier to design a balanced sideband-separating mixer-preamp using waveguide quadrature hybrids and separate component mixers.

Completed designs of two components required for the 230-GHz balanced sideband-separating mixer using waveguide hybrids and four single-ended mixers: (i) A suspended-stripline to waveguide transition for use with split-block waveguide circuits. This has the SS probe in a plane parallel to the interface between the two halves of the block – our earlier SIS mixers had the probe in a plane perpendicular to the waveguide axis. The probe is the same as before -- only the WG circuit has been changed -- which allows our existing mixers can be used. (ii) An H-plane waveguide bend (90-degree) which allows a waveguide in a split-block to connect to another waveguide perpendicular to the interface between the two halves of the block.

4.3 Local Oscillator System

Updated central rack layout for TI photonic reference and DC power requirements for this rack. Ordered two slave lasers for TI laser synthesizers.

Ordered two commercial photomixers for 75-120 GHz bands that will allow us to do test and development until photomixers from RAL are available.

Began detailed design of the holography transmitter and reference feed horns.

Phase locked the Test Interferometer W-band Gunn oscillator to the photonic reference at 83 GHz.

Successfully tested a new laser phase lock technique, using an optical Bragg cell rather than the laser itself to correct the frequency/phase errors in the loop. The phase noise was an improvement over anything we have done previously.

Conducted bench tests on the effect of fiber polarization drift on the level of the photonic reference signal. Using an inexpensive polarization controller we demonstrated that this level could be adjusted and maximized.

4.4 Backend Subsystem

Finished testing five available mixers and started optimize/debug process for testing mixer conversion loss.

Researched data on lowpass filter ICs for the total power detectors.

Wrote specs and RFQ packages for test interferometer digital attenuators 4-12 GHz and for integrated 2x2 matrix switches 4-12 GHz.

4.5 Correlator

Innotech reports that simulation of the custom correlator chip is proceeding well and we will have adequate speed margin for the 125 MHz chip clock rate. They have completed a successful simulation of the core logic. The next step is the final top level simulation. They expect to submit the chip design for layout in early to mid April.

A design review of the correlator card was held and the design should be ready to submit the card to layout shortly. The main concern with this card is the difficult PCB layout (over 5700 nets and 77 large 240-pin quad flat packs).

The re-layout of the test fixture motherboard was completed and is ready for quotes for board fabrication.

Checkout of the Long Term Accumulator/Correlator Control Card (LTACCC) is proceeding smoothly. Work so far has concentrated on control software running in the embedded Infineon C167 processor and on a host PC that will be used by all control cards in the correlator.

Basic operation of individual FPGA devices at 125 MHz, transfer of data between the C167 processor and FPGA chips, and operation of data transfers over the card CAN bus have been verified.

The next stage of work will concentrate on the actual Long Term Accumulation functions required on the card, where the next significant step will be to accomplish write/read control, at 125 MHz, over the large SDRAM data banks that provide the storage for accumulation results.

4.6 Computing

A simple ACS client/server program is now working. Several problems with the ACS installation were identified and corrected. Began implementation of ConvertTime class that will be an ACS server.

Prepared documentation for review of AMBSI designs and revised schematics choosing new static RAMs and fixed some prior errors.

Checked several new code modules into the ESO-NRAO common code repository. These modules connect ACS properties with the AMB CAN bus.

Revised the status of M&C ICDs and sent the list around to Div Heads.

Designed more detail on startup of Test Interferometer system control exec software.

Received complimentary copy of IBM DB2 relational database management system [as educational/ research organization]. Installed DB2 on windows and conducted transaction rate test for NT environment. Even this worst case looks useful. Proceeding to install on linux for a more optimized and tuned configuration. Constructing and testing equipment monitor point data collection and archiving.

4.7 Systems Engineering

Reviewed the current planning for the implementation and operation of the TI and made some modifications to the tasking in this plan. Visited the VLA site to review the current state of the TI site preparation. Discussed safety issues and facilities for the TI with Gene Cole and Guy Stanzio at the VLA site.

Completed detailed specification and vendor for the TI weather instrumentation.

Investigated how TI safety plan should best be organized. Reviewed VLA safety procedures and SOW ALMA System Safety Program proposal commissioned by ESO in this regard.

Tested closed loop software servo control for the nutator . Held progress review and demonstration capabilities for ESO. Studied illumination of nutator housing by receiver feeds.

Received second (cooled) CCD camera. Will begin software integration, testing and mount fabrication ASAP.

The ALMA Documentation Specialist position has been filled. Stacy Oliver has accepted this position and will start in Tucson on April 9th.

Met with Japanese antenna and systems engineers for four days and discussed a wide-range of ALMA issues. Most of our discussions were related to a possible Japanese involvement in the Test Interferometer.

4.8 Imaging and Calibration

Extending the analysis of wind data at the Chajnantor site. Specifically, we have LOTS of data on surface winds, from seven different weather stations in the area, plus radiosonde data, plus estimates of the winds aloft from the interferometer data. Rather than doing a bulk statistical analysis, as was done in ALMA Memo 322 (which is quite valid in its approach for a general comparison of Chajnantor and Pampa la Bola), this analysis is a correlational analysis that will assist in identifying changes within the site.

Restarted submm tipper in lab. Deployment to Chajnantor expected in late April. Planned site campaign for late April.

Held MMA ImCal and ASAC teleconferences; minutes of the ASAC meeting are at http://www.cv.nrao.edu/~awootten/mmaimcal/asac/asacmar01minutes.html

and those for February are at:

http://www.cv.nrao.edu/~awootten/mmaimcal/asac/asacfeb01minutes.htm)

The Configuration PDR report is now complte. It can be found at:

http://www.cv.nrao.edu/~awootten/mmaimcal/configurationpdr.html

MILLIMETER ARRAY/ALMA-US

PROJECT STAFFING

MONTH END MARCH 2001

WBS Task Name	Number Of Persons Participating in Activity*	Full-time Equivalent Employees
Administration	11	6.4
Site Development	1	0.0
Antennas	4	2.5
Front-End	21	17.3
Local Oscillator	11	8.8
IF and Fiber Optics	7	7.0
Correlator	5	4.0
Computing	9	8.5
System Integration	5	4.8
Calibration	3	3.0
TOTAL:	77.0	62.3

* Several persons in this column are counted two or more times. These particular individuals are involved part-time in more than one activity.

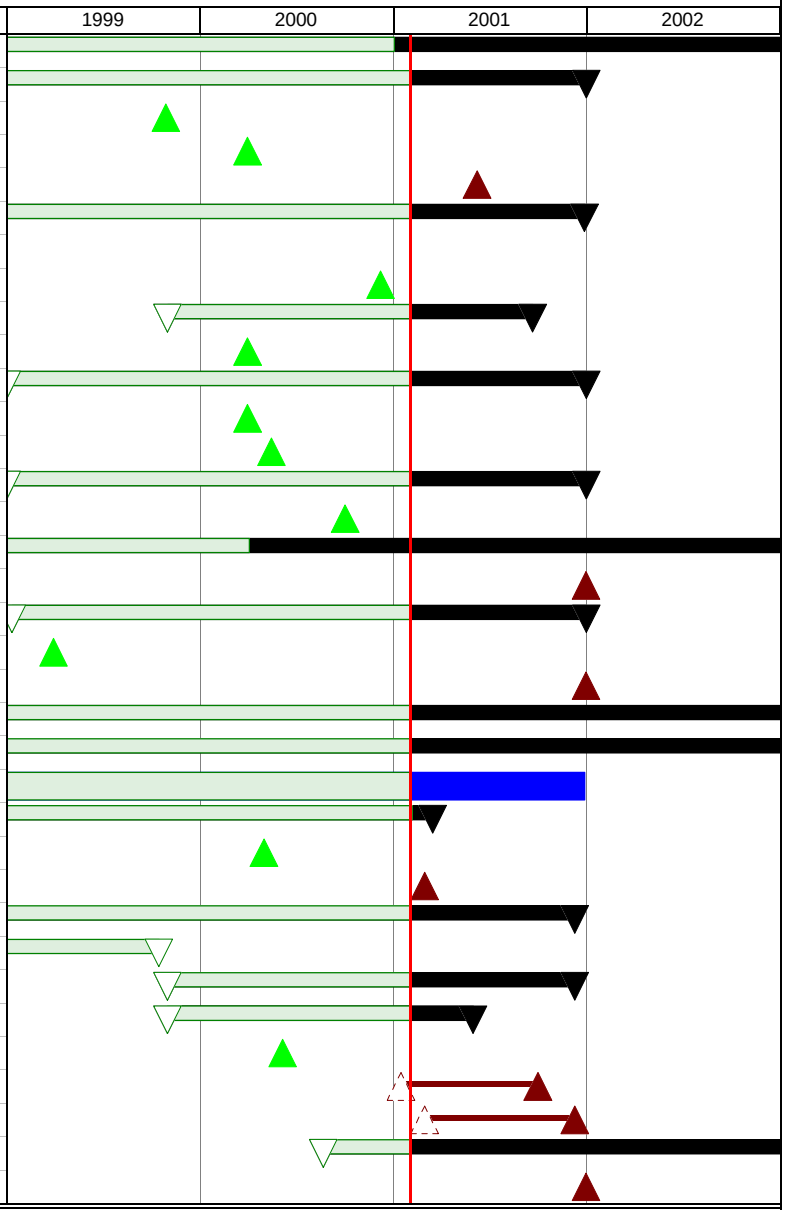
Atacama Large Millimeter Array

ALMA Milestone Progress

Phase 1 Major Milestones and Tasks selected

File: almaplan.mpp
View: ALMA Phase 1 Progress

Line	WBS (f)	Task	Start	Finish	%done
1	**1**	**Management/Administration**	1998-06-01	2010-12-31	45%
2	1.05	Phase 1 Management	1998-06-01	2001-12-31	75%
4	**1.05.10**	**Deliver WBS for ALMA D&D phase**	**1999-10-28**	**1999-10-28**	**100%**
6	**1.05.20**	**Deliver final WBS for ALMA project**	**2000-03-31**	**2000-03-31**	**100%**
7	**1.05.22**	**Review: ALMA Management Advisory Committee**	**2001-06-08**	**2001-06-08**	**0%**
8	1.05.25	Project Book	1998-06-01	2001-12-28	74%
10	**1.05.25.10**	**MMA Project Book: Version 1**	**1998-07-20**	**1998-07-20**	**100%**
11	**1.05.25.15**	**ALMA Project Book: Joint Version**	**2000-12-08**	**2000-12-08**	**100%**
12	1.05.30	Phase 1 Joint Management Plan	1999-11-01	2001-09-21	65%
14	**1.05.30.10**	**Deliver Phase 1 Joint Management Plan**	**2000-03-31**	**2000-03-31**	**100%**
54	1.10	Phase 2 Planning	1999-01-01	2001-12-31	66%
57	**1.10.15**	**Deliver Baseline Scope of Phase 2**	**2000-03-31**	**2000-03-31**	**100%**
59	**1.10.25**	**Deliver Draft Phase 2 Plan**	**2000-05-15**	**2000-05-15**	**100%**
61	1.10.35	Management Planning	1999-01-01	2001-12-31	72%
62	**1.10.35.05**	**Deliver Management Plan for Construction**	**2000-10-02**	**2000-10-02**	**100%**
77	1.20	Agreements in Chile	1998-06-01	2010-12-31	22%
79	**1.20.10**	**CONICYT Use Permissions**	**2001-12-31**	**2001-12-31**	**0%**
86	1.25	Partnerships and Agreements	1999-01-11	2001-12-31	64%
88	**1.25.10**	**Partnership Recommendations to NSF**	**1999-03-30**	**1999-03-30**	**100%**
91	**1.25.25**	**Final ALMA Partnership Agreements**	**2001-12-31**	**2001-12-31**	**0%**
96	**2**	**Site Development**	1998-06-01	2010-12-31	24%
97	2.05	Site Development Management	1998-06-01	2006-01-19	31%
98	2.05.03	Site Development Management Phase 1	1998-06-01	2001-12-28	75%
102	2.07	Site Development Requirements	1998-06-01	2001-03-16	96%
104	**2.07.10**	**Deliver Initial Operations Plan**	**2000-05-01**	**2000-05-01**	**100%**
105	**2.07.15**	**Deliver Revised Operations Plan**	**2001-03-01**	**2001-03-01**	**0%**
106	2.10	Development Plans	1998-06-01	2001-12-10	88%
107	2.10.05	Prepare Preliminary Development Plan	1998-06-01	1999-10-15	100%
116	2.10.10	Estimate Development Costs	1999-11-01	2001-12-10	67%
117	2.10.10.05	Prepare Initial Plan	1999-11-01	2001-05-31	82%
125	**2.10.10.05.38**	**Deliver Initial Site Development Plan**	**2000-06-05**	**2000-06-05**	**100%**
135	**2.10.10.15**	**PDR: Site Development Plan**	**2001-10-01**	**2001-10-01**	**0%**
137	**2.10.10.25**	**Deliver revised development Plan**	**2001-12-10**	**2001-12-10**	**0%**
138	2.15	Site Legal Issues	2000-08-21	2010-12-31	2%
139	**2.15.05**	**(CONICYT Use Permissions Delivered from WBS 1)**	**2001-12-31**	**2001-12-31**	**0%**



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

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

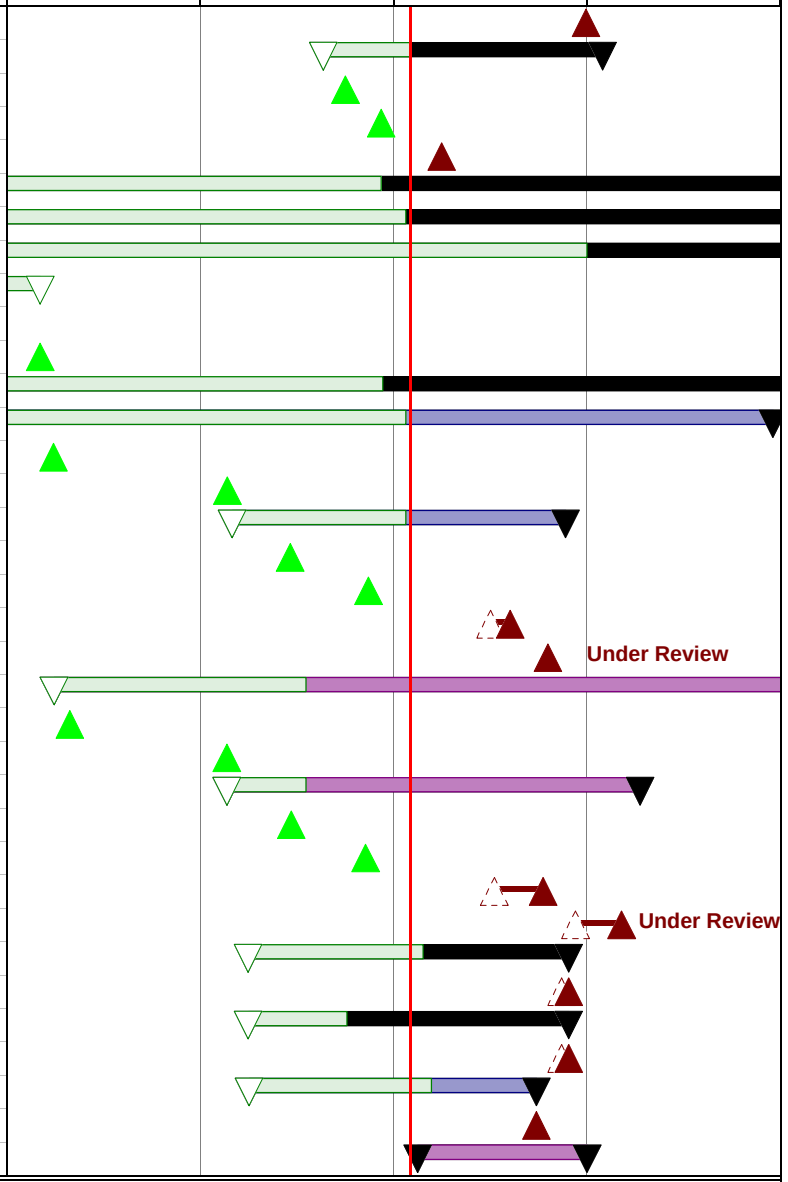
Atacama Large Millimeter Array

ALMA Milestone Progress

File: almaplan.mpp
View: ALMA Phase 1 Progress

Phase 1 Major Milestones and Tasks selected

Line	WBS (f)	Task	Start	Finish	%done
140	**2.15.10**	**(Access to OSF Land Delivered from WBS 1)**	**2001-12-31**	**2001-12-31**	**0%**
141	2.15.15	Process Environmental Documents (EIA)	2000-08-21	2002-01-31	22%
143	**2.15.15.07**	**EIA Started**	**2000-10-02**	**2000-10-02**	**100%**
144	**2.15.15.10**	**Deliver Initial EIA**	**2000-12-09**	**2000-12-09**	**100%**
146	**2.15.15.20**	**Submit EIA Documents**	**2001-04-02**	**2001-04-02**	**0%**
252	**3**	**Antenna Subsystem**	1998-06-01	2010-12-31	20%
253	3.05	Antenna Management/Subsystem Engineering	1998-06-01	2010-12-31	19%
256	3.05.10	Antenna Subsystem Engineering	1998-06-01	2010-07-01	16%
257	3.05.10.05	Antenna Subsystem Design & Specification	1998-06-01	1999-03-05	100%
263	**3.05.10.05.30**	**Antenna PDR**	**1998-07-28**	**1998-07-28**	**100%**
265	**3.05.10.05.40**	**CDR: Antenna RFP/CfT**	**1999-03-05**	**1999-03-05**	**100%**
267	3.10	Prototype Antennas	1998-09-22	2003-04-11	41%
268	3.10.05	U.S. Prototype Antenna	1998-09-22	2002-12-19	41%
271	**3.10.05.15**	**Issue Prototype Antenna RFP**	**1999-03-30**	**1999-03-30**	**100%**
275	**3.10.05.35**	**Sign Contract (Prototype Antenna #1)**	**2000-02-22**	**2000-02-22**	100%
276	3.10.05.40	US Prototype antenna contract supervision	2000-03-02	2001-11-22	54%
278	**3.10.05.40.10**	**Vertex Prototype antenna PDR**	**2000-06-20**	**2000-06-20**	**100%**
279	**3.10.05.40.15**	**Vertex Prototype antenna CDR**	**2000-11-15**	**2000-11-15**	**100%**
285	**3.10.05.40.22**	**Vertex Prototype Site Assembly Start**	**2001-08-10**	**2001-08-10**	**0%**
289	**3.10.05.40.45**	**Deliver Vertex Prototype Antenna**	**2001-10-20**	**2001-10-20**	**0%**
296	3.10.10	European Antenna Prototype Procurement	1999-03-31	2003-04-11	26%
298	**3.10.10.10**	**Issue prototype antenna CfT**	**1999-04-30**	**1999-04-30**	**100%**
302	**3.10.10.30**	**Sign prototype antenna #2 contract**	**2000-02-21**	**2000-02-21**	**100%**
303	3.10.10.35	Prototype antenna contract supervision	2000-02-21	2002-04-12	22%
305	**3.10.10.35.10**	**EIE Prototype antenna PDR**	**2000-06-22**	**2000-06-22**	**100%**
306	**3.10.10.35.15**	**EIE Prototype antenna CDR**	**2000-11-09**	**2000-11-09**	**100%**
310	**3.10.10.35.28**	**EIE Starts Installation on Site**	**2001-10-11**	**2001-10-11**	**0%**
316	**3.10.10.35.45**	**Deliver EIE Prototype Antenna**	**2002-03-08**	**2002-03-08**	**0%**
322	3.10.20	Vertex Metrology/Test Equipment	2000-04-01	2001-11-28	61%
348	**3.10.20.40**	**Deliver Vertex Antenna Metrology System**	**2001-11-28**	**2001-11-28**	**0%**
350	3.10.22	EIE Metrology/Test Equipment	2000-04-01	2001-11-28	34%
376	**3.10.22.40**	**Deliver EIE Antenna Metrology System**	**2001-11-28**	**2001-11-28**	**0%**
378	3.10.25	Prototype Vertex Nutator	2000-04-03	2001-09-28	63%
382	**3.10.25.15**	**Deliver Prototype Vertex Nutator**	**2001-09-28**	**2001-09-28**	**0%**
384	3.10.27	Prototype EIE Nutator	2001-02-16	2002-01-02	0%



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

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

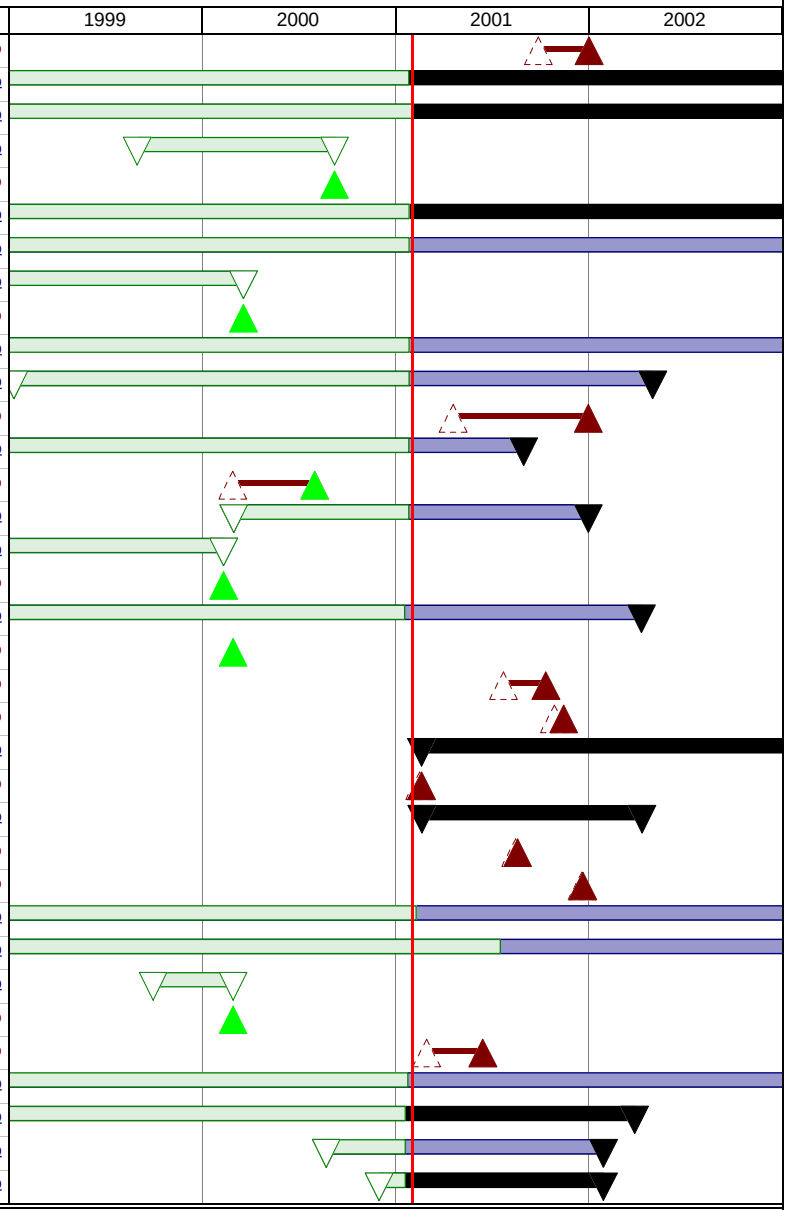
Atacama Large Millimeter Array

ALMA Milestone Progress

File: almaplan.mpp
View: ALMA Phase 1 Progress

Phase 1 Major Milestones and Tasks selected

Line	WBS (f)	Task	Start	Finish	%done
386	**3.10.27.15**	**Deliver Prototype EIE Nutator**	**2002-01-02**	**2002-01-02**	**0%**
422	**4**	**Front End Subsystem**	1998-06-01	2010-12-31	24%
423	4.05	Front End Management/Subsystem Engineering	1998-06-01	2010-12-31	28%
428	4.05.10	Front End Subsystem Design & Specification	1999-09-01	2000-09-08	100%
432	**4.05.10.20**	**Final Front End Specifications**	**2000-09-08**	**2000-09-08**	**100%**
436	4.10	SIS Mixer Development	1998-06-01	2003-12-17	73%
442	4.10.10	Balanced, sideband separating SIS mixers	1998-06-01	2003-12-17	74%
443	4.10.10.05	Specifications	1998-06-01	2000-03-20	100%
445	**4.10.10.05.10**	**Review: SIS Mixer**	**2000-03-20**	**2000-03-20**	**100%**
505	4.10.10.40	Mixers	1998-06-01	2003-12-17	61%
510	4.10.10.40.10	230 GHz	1999-01-11	2002-05-02	67%
558	**4.10.10.40.10.25**	**Deliver prototype 230 GHz Mixer**	**2001-12-31**	**2001-12-31**	**0%**
580	4.10.10.45	Automated Mixer Testing	1998-06-01	2001-08-31	82%
585	**4.10.10.45.25**	**Complete automated mixer characterization**	**2000-08-01**	**2000-08-01**	**100%**
601	4.10.10.53	Integrated IF	2000-03-01	2001-12-31	29%
607	4.10.10.55	Vacuum Windows	1998-06-01	2000-02-11	100%
617	**4.10.10.55.50**	**Complete 86 GHz Vac. Window Development**	**2000-02-11**	**2000-02-11**	**100%**
666	4.20	Antenna Evaluation Front Ends	1998-10-27	2002-04-11	74%
674	**4.20.40**	**Review: Evaluation Front End**	**2000-02-29**	**2000-02-29**	**100%**
680	**4.20.70**	**Deliver Antenna Test Eval Front End #1**	**2001-10-12**	**2001-10-12**	**0%**
682	**4.20.80**	**Deliver Antenna Test Eval Front End #2**	**2001-11-15**	**2001-11-15**	**0%**
683	4.25	Prototype Front Ends	2001-02-19	2004-03-04	0%
684	**4.25.05**	**PDR: Front End Subsystem**	**2001-02-19**	**2001-02-19**	**0%**
685	4.25.10	Front End Engineering Model	2001-02-20	2002-04-12	0%
698	**4.25.10.20**	**Front End Eng. Model Progress Review 2**	**2001-08-20**	**2001-08-20**	**0%**
699	**4.25.10.25**	**Deliver Front End Eng. Model Components**	**2001-12-21**	**2001-12-21**	**0%**
764	**5**	**Local Oscillator Subsystem**	1998-06-01	2010-12-31	18%
765	5.05	LO Management/Subsystem Engineering	1998-06-01	2010-12-31	20%
769	5.05.15	LO Ref system definition	1999-10-01	2000-02-29	100%
773	**5.05.15.20**	**PDR: LO Reference**	**2000-02-29**	**2000-02-29**	**100%**
774	**5.05.17**	**PDR: LO Subsystem**	**2001-06-15**	**2001-06-15**	**0%**
779	5.10	Prototype LO	1998-06-01	2009-12-24	49%
780	5.10.03	LO Reference US Phase 1	1998-06-01	2002-03-29	58%
784	5.10.05.10	LO Reference Test Int Prototype Modules	2000-08-23	2002-01-29	34%
785	5.10.05.10.10	FO Receiver, LO Reference	2000-12-01	2002-01-29	17%



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

Joint Task
Eur Task
US Task
Summary (Joint)
Summary (Eur)
Summary (US)
Milestone
Progress
Completed Mlstn

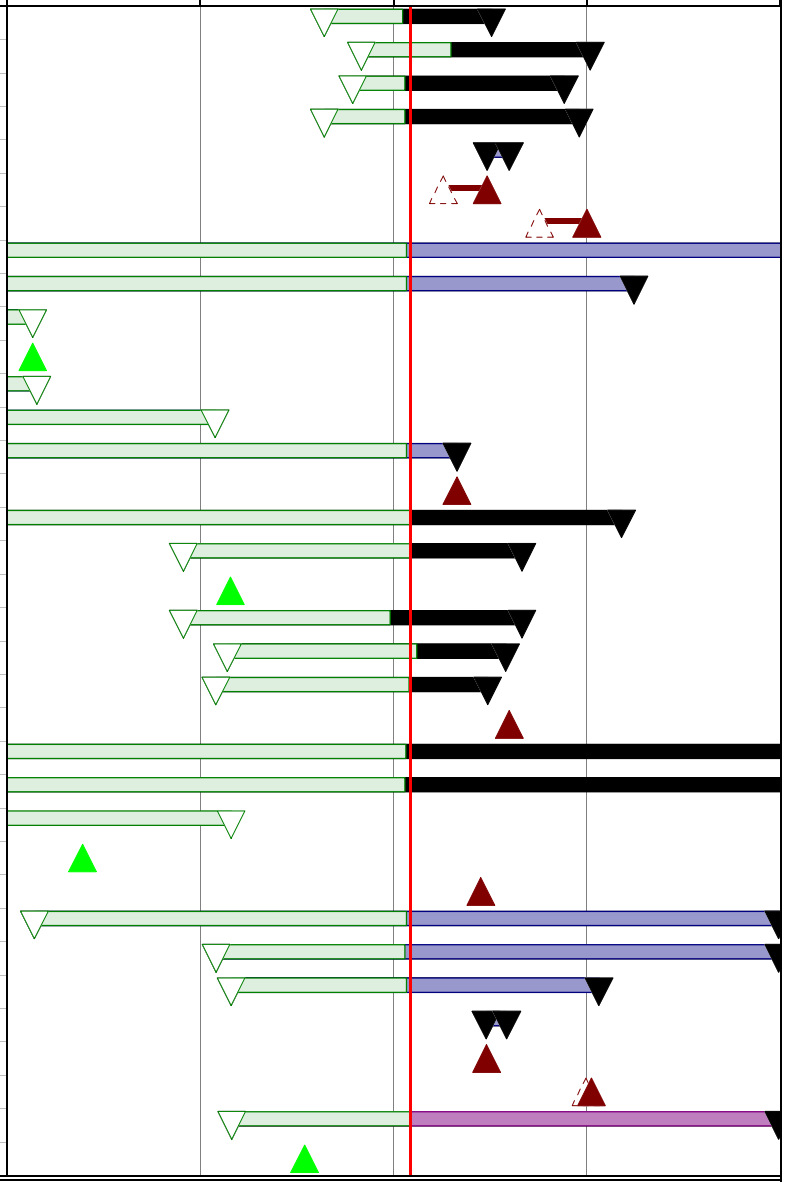
Atacama Large Millimeter Array

ALMA Milestone Progress

File: almaplan.mpp
View: ALMA Phase 1 Progress

Phase 1 Major Milestones and Tasks selected

Line	WBS (f)	Task	Start	Finish	%done
820	5.10.05.10.15	Two-Laser generator, RF synthesizer	2000-08-23	2001-07-05	32%
831	5.10.05.10.20	Second LO synthesizer	2000-11-01	2002-01-08	19%
866	5.10.05.10.25	Fringe Generator	2000-10-16	2001-11-20	29%
901	5.10.05.10.30	Central LO Reference Generator / FO Xmtr	2000-08-23	2001-12-18	54%
936	5.10.05.15	LO Ref Bench system, integrate and test	2001-06-27	2001-08-08	0%
939	**5.10.05.15.15**	**Deliver LO Ref bench prototype**	**2001-06-27**	**2001-06-27**	**0%**
940	**5.10.05.25**	**Deliver LO Ref field prototype**	**2002-01-01**	**2002-01-01**	**0%**
946	5.10.10	Multiplier Chain LO Prototype	1998-06-01	2003-07-03	58%
965	5.10.10.15	Multiplier R&D	1998-06-01	2002-04-01	69%
966	5.10.10.15.05	Prototype multiplier development	1998-06-01	1999-02-19	100%
969	**5.10.10.15.05.15**	**PDR: Multiplier Chain LO**	**1999-02-19**	**1999-02-19**	**100%**
970	5.10.10.15.10	55->110 GHz Doubler (Band 9)	1998-06-01	1999-02-26	100%
982	5.10.10.15.15	110->220 GHz Doubler (Band 9)	1998-06-03	2000-01-30	100%
995	5.10.10.15.20	80->240 GHz Tripler (Band 6)	1998-08-03	2001-05-01	93%
1001	**5.10.10.15.20.30**	**Deliver Prototype 80-240GHz tripler**	**2001-05-01**	**2001-05-01**	**0%**
1049	5.10.15	Photonic LO Distribution Prototype	1998-06-01	2002-03-08	63%
1052	5.10.15.48	Photonic Distribution Development	1999-12-01	2001-09-01	61%
1053	**5.10.15.48.05**	**PDR: Photonic Distribution**	**2000-02-28**	**2000-02-28**	**100%**
1054	5.10.15.48.10	Photomixer Modules	1999-12-01	2001-09-01	79%
1064	5.10.15.48.15	Laser Synthesizer and Phase Lock	2000-02-22	2001-08-01	58%
1073	5.10.15.48.20	Correctors for F/O round trip	2000-01-31	2001-06-28	72%
1084	**5.10.15.55**	**Deliver Photonic LO Dist Prototype**	**2001-08-08**	**2001-08-08**	**0%**
1142	**6**	**Backend Subsystem**	1998-06-01	2010-12-31	19%
1143	6.05	Backend Management/Subsystem Engineering	1998-06-01	2010-12-31	25%
1146	6.05.10	Backend system definition	1998-11-02	2000-02-29	100%
1151	**6.05.10.25**	**Decision: Analog/Digital Transmission**	**1999-05-24**	**1999-05-24**	**100%**
1154	**6.05.16**	**Backend Subsystem PDR**	**2001-06-15**	**2001-06-15**	**0%**
1158	6.10	Prototype Backend Subsystem	1999-02-22	2002-12-30	41%
1160	6.10.10	Test Int IF Down-Converter	2000-02-01	2002-12-30	45%
1167	6.10.15	Test Int Data Transmission System	2000-02-29	2002-01-24	44%
1378	6.10.20	Bench system, integrate and test	2001-06-25	2001-08-03	0%
1381	**6.10.20.15**	**Deliver Backend bench prototype**	**2001-06-26**	**2001-06-26**	**0%**
1383	**6.10.24**	**Deliver Test Int Backend Field Prototype**	**2002-01-10**	**2002-01-10**	**0%**
1386	6.10.45	Prototype Digitizer/Sampler	2000-03-01	2002-12-30	31%
1388	**6.10.45.10**	**Pre-prototype ASIC design to foundry (CMOS)**	**2000-07-17**	**2000-07-17**	**100%**



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Summary (US)
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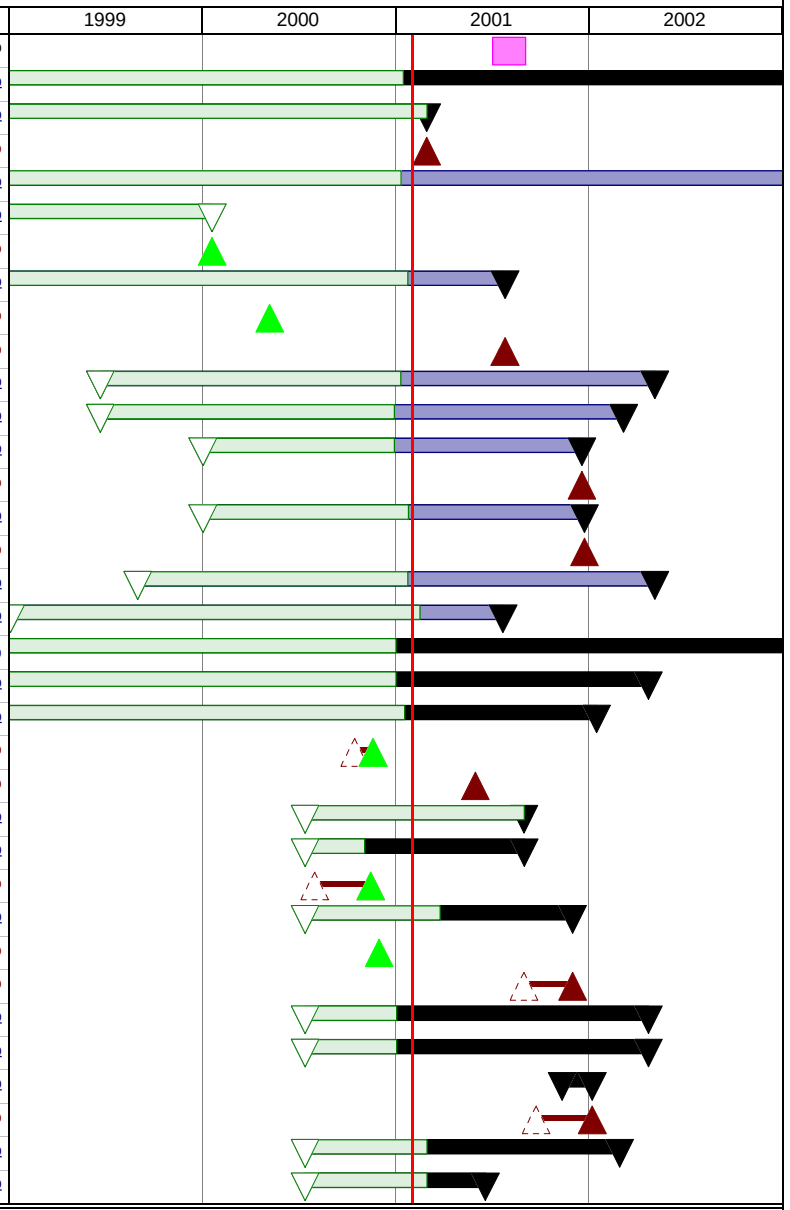
Line	WBS (f)	Task	Start	Finish	%done
1393	6.10.45.35	Test Bench qualification tests	2001-07-03	2001-09-03	0%
1411	**7**	**Correlator**	1998-06-01	2010-12-31	22%
1419	7.10	Test Correlator	1998-07-20	2001-03-01	99%
1425	**7.10.30**	**Deliver Test Correlator to Alma Test site**	**2001-03-01**	**2001-03-01**	**0%**
1426	7.15	Baseline Correlator	1998-07-03	2008-04-23	40%
1427	7.15.05	Baseline Correlator Preliminary Design	1998-09-15	2000-01-20	100%
1432	**7.15.05.25**	**PDR: Correlator**	**2000-01-20**	**2000-01-20**	**100%**
1433	7.15.10	Finite Impulse Response Filter Development	1998-07-03	2001-07-27	86%
1444	**7.15.10.40**	**PDR: Finite Impulse Response Filter**	**2000-05-08**	**2000-05-08**	**100%**
1451	**7.15.10.85**	**FIR Filter Performance Report**	**2001-07-27**	**2001-07-27**	**0%**
1452	7.15.15	Custom Board Development	1999-06-23	2002-05-06	44%
1453	7.15.15.05	Station Card	1999-06-23	2002-03-08	30%
1466	7.15.15.10	Correlator Card	2000-01-03	2001-12-19	52%
1475	**7.15.15.10.55**	**Deliver Correlator Card**	**2001-12-19**	**2001-12-19**	**0%**
1476	7.15.15.15	Long-Term Accumulator	2000-01-03	2001-12-24	46%
1485	**7.15.15.15.55**	**Deliver Long Term Accumulator**	**2001-12-24**	**2001-12-24**	**0%**
1486	7.15.15.20	System Control Card	1999-09-02	2002-05-06	47%
1496	7.15.20	Correlator Chip Development	1999-01-04	2001-07-23	82%
1545	**8**	**Computing Subsystem**	1998-06-01	2010-12-31	**4%**
1	8.03	Computing Development (Phase 1)	1998-06-01	2002-04-24	48%
2	8.03.05	Management	1998-06-01	2002-01-16	72%
6	**8.03.05.20**	**US/European Joint Software Meeting**	**2000-11-20**	**2000-11-21**	**100%**
8	**8.03.05.30**	**Deliver Phase 2 Computing Plan**	**2001-06-01**	**2001-06-01**	**0%**
10	8.03.10	Science Software Requirements	2000-07-14	2001-09-01	99%
17	8.03.15	High Level Analysis and Design	2000-07-14	2001-09-02	50%
18	**8.03.15.05**	**Computer Design Concept**	**2000-11-15**	**2000-11-15**	**100%**
37	8.03.25	ALMA Common Software	2000-07-14	2001-12-02	9%
43	**8.03.25.30**	**Kitt Peak ACS test**	**2000-12-01**	**2000-12-01**	**100%**
47	**8.03.25.50**	**Release of ACS for Test Interferometer**	**2001-12-02**	**2001-12-02**	**0%**
48	8.03.30	Control Software	2000-07-14	2002-04-24	33%
49	8.03.30.05	Test Interferometer Control Software	2000-07-14	2002-04-24	33%
204	8.03.30.80	TICS 1.0: Single Dish/Total Power	2001-11-12	2002-01-08	0%
211	**8.03.30.80.35**	**TICS Release 1.0**	**2002-01-08**	**2002-01-08**	**0%**
226	8.03.35	Correlator Software	2000-07-14	2002-03-01	43%
227	8.03.35.05	Test Correlator	2000-07-14	2001-06-20	66%



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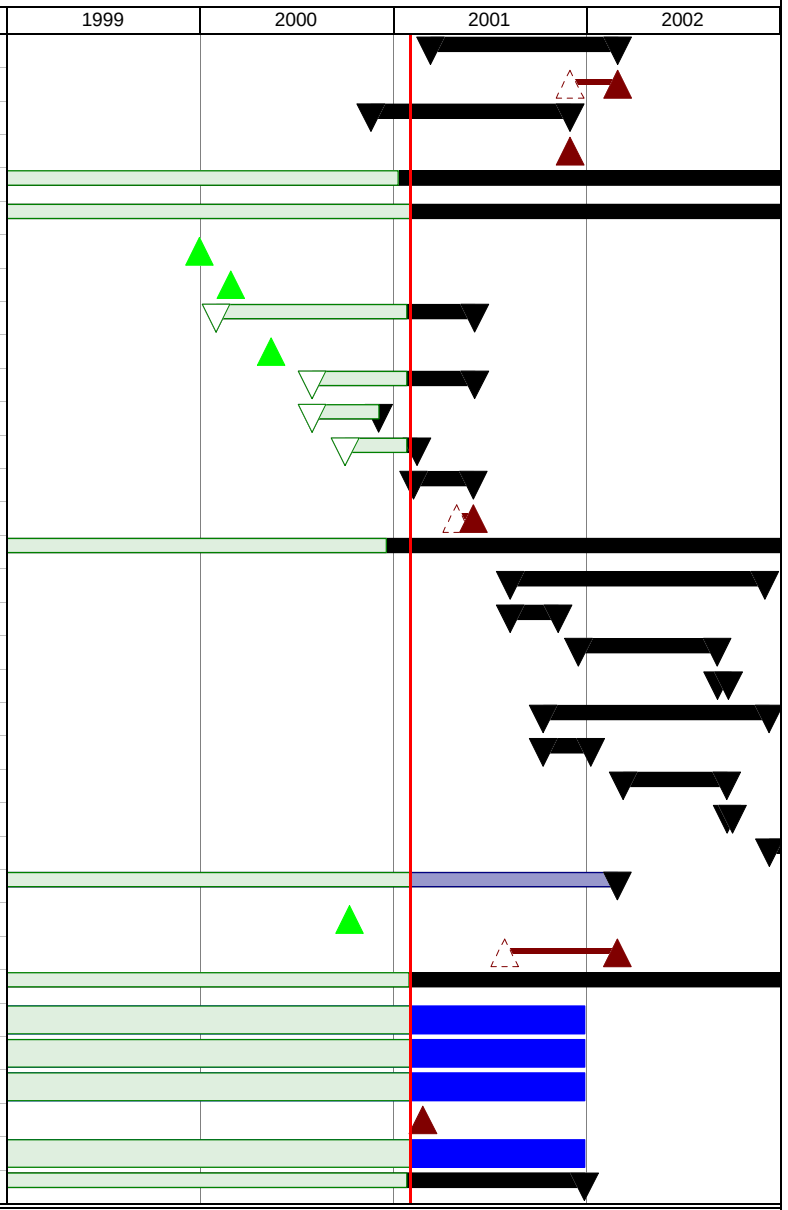
Line	WBS (f)	Task	Start	Finish	%done
237	8.03.37	Prototype Correlator	2001-03-12	2002-03-01	0%
244	**8.03.37.35**	**CDR: Prototype Correlator Software**	**2002-03-01**	**2002-03-01**	**0%**
270	8.03.65	Telescope Calibration	2000-11-19	2001-12-01	0%
276	**8.03.65.30**	**Release for Test Interferometer**	**2001-12-01**	**2001-12-01**	**0%**
1546	**9**	**System Engineering & Integration**	1998-06-01	2010-12-31	14%
1549	9.10	System Engineering	1998-06-01	2010-12-31	25%
1551	**9.10.10**	**System Block Diagram for Array**	**1999-12-31**	**1999-12-31**	**100%**
1553	**9.10.20**	**System Design Review**	**2000-02-28**	**2000-02-28**	**100%**
1556	9.12	Test Site Preparation/Outfitting	2000-02-01	2001-06-04	72%
1558	**9.12.10**	**Design Review: Test Int. Site Preparation**	**2000-05-15**	**2000-05-15**	**100%**
1559	**9.12.15**	**ALMATSF**	2000-07-31	2001-06-04	67%
1	9.12.15.05	PROCURE TEST SITE MATERIALS	2000-07-31	2000-12-04	99%
25	9.12.15.20	ANTENNA TEST SITE PREPARATION	2000-10-02	2001-02-14	82%
56	9.12.15.25	ANTENNA SITE FOUNDATIONS	2001-02-08	2001-06-01	0%
1561	**9.12.35**	**Test Interferometer Site Complete**	**2001-06-01**	**2001-06-01**	**0%**
1594	**9.15**	**ALMA Prototype Interferometer Evaluation**	**1998-06-01**	**2003-12-16**	8%
7	9.15.20	Vertex Antenna Integration and Testing	2001-08-10	2002-12-04	0%
9	9.15.20.10	Vertex Antenna Installation	2001-08-10	2001-11-08	0%
49	9.15.20.30	Vertex Antenna Systems Installation and Testing	2001-12-17	2002-09-05	0%
110	9.15.20.40	Millimeter Receiver Installation and Tests (Vertex)	2002-09-06	2002-09-26	0%
149	9.15.30	EIE Antenna Integration and Testing	2001-10-11	2002-12-12	0%
151	9.15.30.10	EIE Antenna Installation	2001-10-11	2002-01-09	0%
191	9.15.30.30	EIE Antenna Systems Installation and Testing	2002-03-11	2002-09-23	0%
248	9.15.30.35	Millimeter Receiver Installation and Tests (EIE)	2002-09-24	2002-10-04	0%
285	9.15.40	Interferometer Tests	2002-12-13	2003-03-11	0%
1595	9.20	Holography System	1998-09-01	2002-02-28	32%
1600	**9.20.25**	**CDR: Holography System**	**2000-10-10**	**2000-10-10**	**100%**
1611	**9.20.30**	**Deliver Holography System**	**2002-02-28**	**2002-02-28**	**0%**
1621	**10**	**Science**	1998-06-01	2009-12-31	54%
1622	10.05	Scientific Requirements	1998-06-01	2001-12-28	74%
1623	10.10	Site Monitoring and Characterization	1998-06-01	2001-12-28	74%
1624	10.15	Array Design and Operation	1998-06-01	2001-12-28	74%
1625	**10.17**	**PDR: ALMA Array Layout**	**2001-02-26**	**2001-02-26**	**0%**
1626	10.20	Calibration	1998-06-01	2001-12-28	74%
1627	10.25	Imaging	1998-06-01	2001-12-28	74%



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