

Project Overview and Status

EVLA Advisory Committee Meeting, March 19-20, 2009



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EVLA Project Manager

Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array



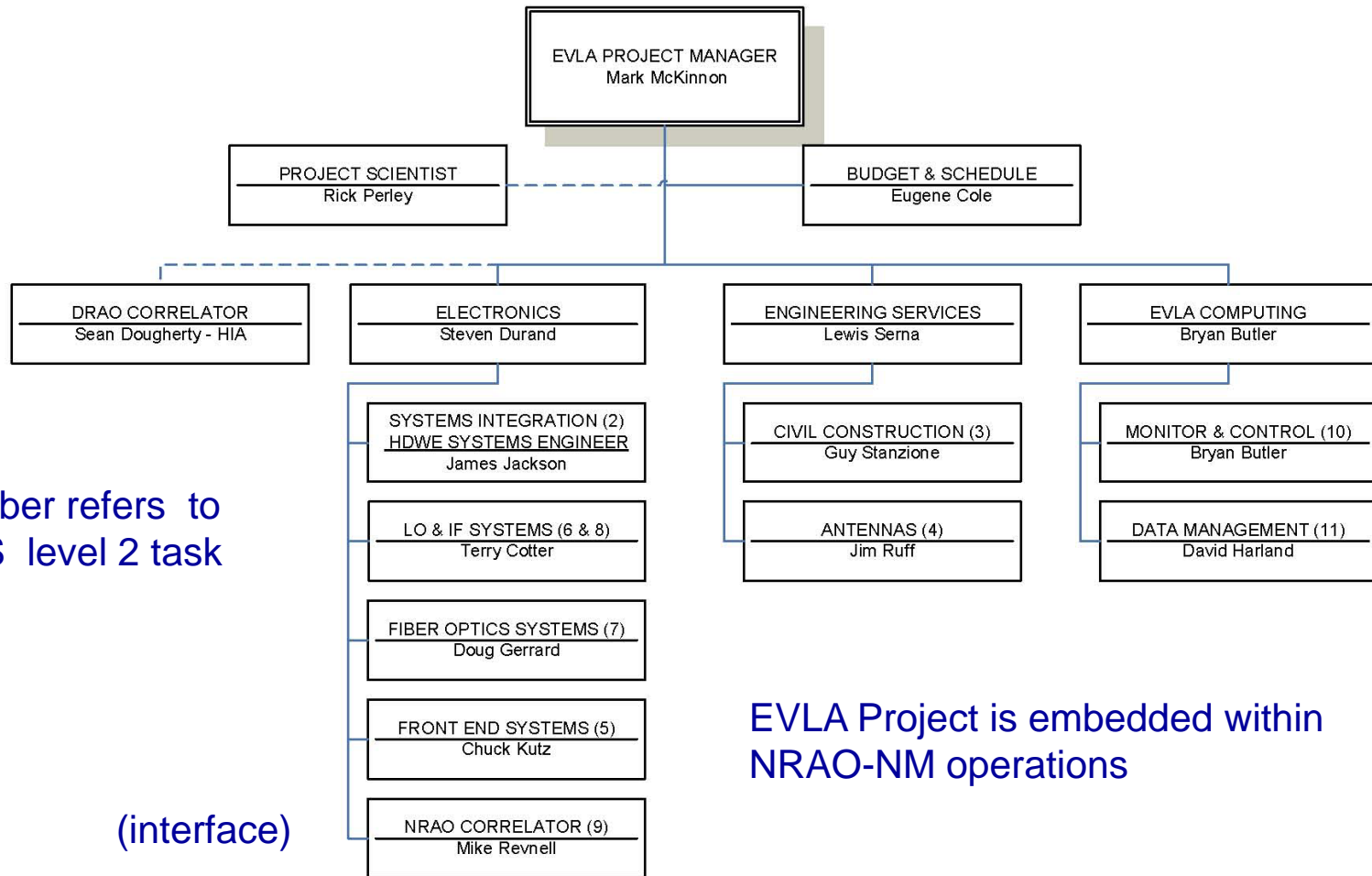
Outline

- Project Goals
- Organization
- Staffing
- Progress since last meeting
- Budget
 - Contingency
 - Risk Management
- Schedule

Project Goals

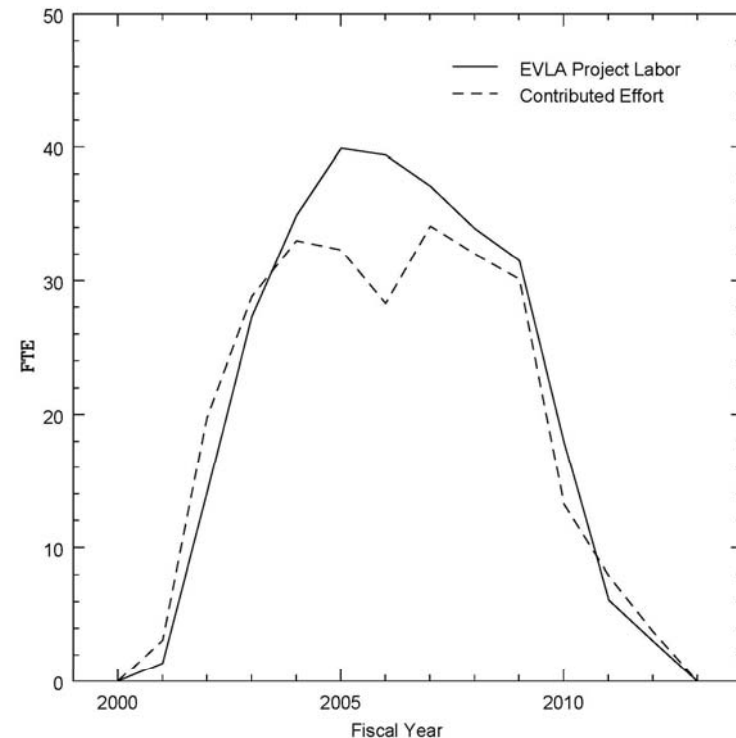
- Key goal: Improve the observational capabilities of the VLA (except for angular resolution) by a factor of ten or more. Achieve by:
 - Adding new, wide bandwidth receivers
 - Upgrading or replacing current receivers
 - Replacing the data transmission system
 - Replacing the correlator
- Provide a new monitor and control system, which must also allow operation of new and old antennas in transition.
- Perform careful astronomical observations to verify that EVLA hardware and software function properly.
- Provide new data management software, to include data post processing, for better access to array data products (effort distributed across divisions of NRAO)

Organization



Staffing

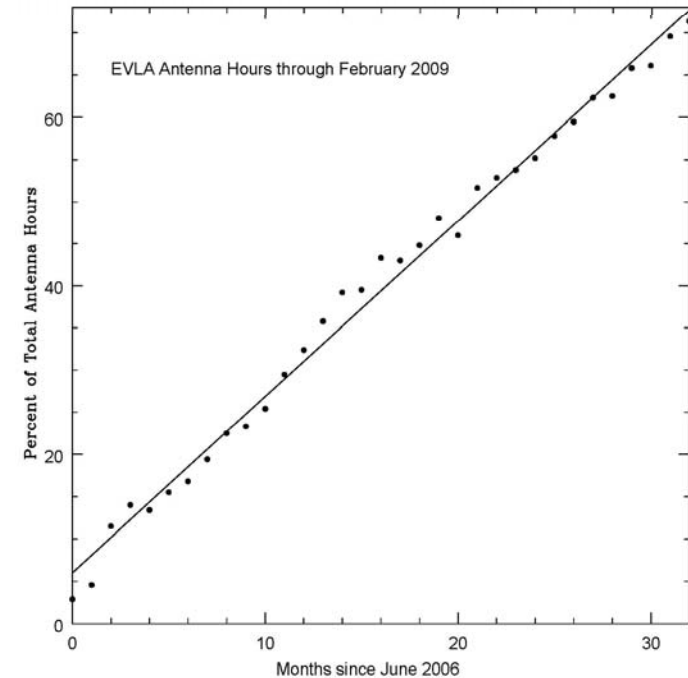
- Labor to complete project is supported by two funding accounts:
 - Labor paid directly by funds allocated to EVLA project
 - “Contributed effort” paid by other NRAO Operations funds
- Labor split is about 50/50 between accounts
 - 286 FTE-years from EVLA project
 - 266 FTE-years of contributed effort
- Project success is tied to continued support of both project and operations funding
- Plan developed to transfer some project personnel to operations budget
 - Establishes base staff level for EVLA technical operations
 - Retains mission-critical personnel in long term EVLA operations
 - Actively used to manage staffing levels



Progress Since Last Meeting

Antennas

- Antenna conversions on track for completion in Q3 2010
 - Antennas placed in operation immediately after retrofit is complete
 - 20 EVLA antennas now in use
 - Account for 71.4% of total antenna hours used in observations
 - Electronics outfitting of 21st antenna underway
 - Mechanical overhaul of 22nd antenna just started
 - Proceeding at desired rate of about 6 per year



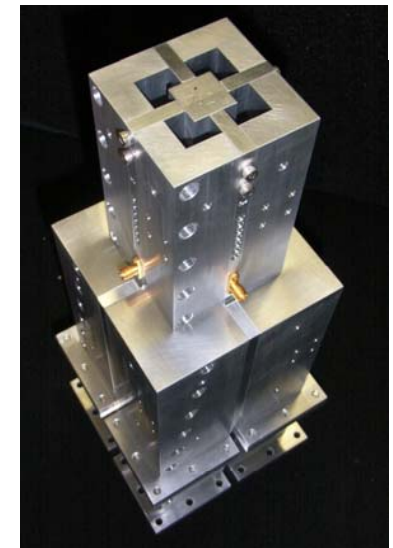
Front Ends

- Excellent progress on feed horn fabrication
 - All horns fabricated for L, C, and Ka-bands
 - Fabrication of S- and Ku-band horns underway
- Full production of Ka-band receivers underway
 - First fringes on one baseline in Aug 2008
 - 8 receivers installed in array now
 - Call for Ka-band proposals issued in Jan 2009
- Design and fabrication issues with OMTs resolved [Hayward/Coutts]
 - L, C, and S-band OMTs meeting specifications
 - Design of X-band OMT nearly complete
- First S-band receiver deployed
- Production of EVLA L-band receivers to begin in FY2009
- Prototype EVLA Ku-band receiver under development

L-band horns



S-band OMT



LO/IF

- Production of local oscillator (LO) and intermediate frequency (IF) modules is slightly ahead of antenna conversion schedule
 - Module assembly should be complete by the end of 2009
- Wideband upgrade (from existing 1GHz bandwidth per downconverter module to 2x2GHz) is underway. Includes:
 - Wideband filters
 - Gain slope equalizers
 - Second set of synthesizers
- Modules for round trip phase measurement placed in production
- Significant progress made in resolving mechanical and thermal issues affecting phase stability [Jackson]

Fiber Optics and Data Acquisition

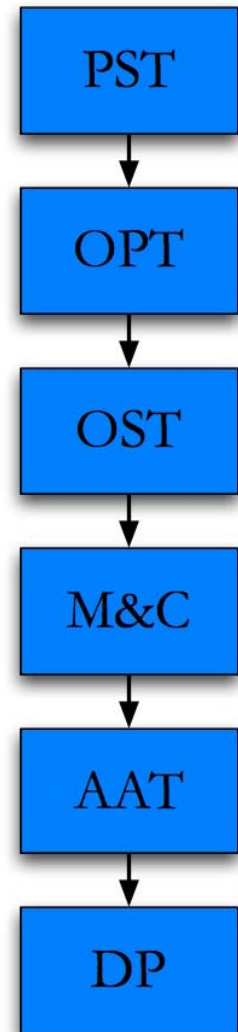
- Production of all modules for the data transmission system (DTS), except high speed sampler, is keeping pace with antenna retrofits
- Fiber infrastructure completed in 2007
 - Provides flexibility in locating antennas on the array
- High Speed Samplers (3-bit, 4Gbps) [Durand/Revnell]
 - Digitizer chips delivered and perform to specification
 - Issues with serial-to-parallel converter on sampler board delayed production
 - Expect production to commence this summer
 - Need WIDAR correlator to exploit capability

WIDAR Correlator

- S. Dougherty became new WIDAR project lead at DRAO
- Internal review of WIDAR management held in Feb 2008
 - Led to improved communication on management issues
- Production review of correlator boards held in Dec 2008
 - NRAO conducted on-the-sky tests of prototype in support of the review [Rupen]
 - First fringes with WIDAR prototype recorded in Aug 2008
 - Production order for station boards placed in Jan 2009
- Other major milestones achieved [Dougherty]
 - Custom correlator chips (12,000) received in Apr 2008
 - Data cables and all 16 racks installed in Jun-Aug 2008
 - First fringes with subset of final WIDAR recorded on Mar 6, 2009

Software

- Proposal submission tool (PST)
 - Used for all VLA, VLBA, and GBT proposals
- Observation preparation tool (OPT) [Harland]
 - Replacement for VLA jobserve
 - Used to support call for Ka-band proposals
 - Current development focused on WIDAR support
- Observation scheduling tool (OST)
 - Dynamically scheduled system now in place
 - Development based on experience with dynamic scheduling of VLA
- Monitor and Control (M&C) [Butler]
 - In 2007, implemented a new M&C system while continuing to support scientific observations with old and new antennas
 - Systems integration of WIDAR underway
- Archive access tool (AAT)
 - In place for EVLA, VLBA, and GBT data retrieval
 - Uses storage technology from ALMA's Next Generation Archive System
 - Developed standardized binary data format and science data model that is shared with ALMA

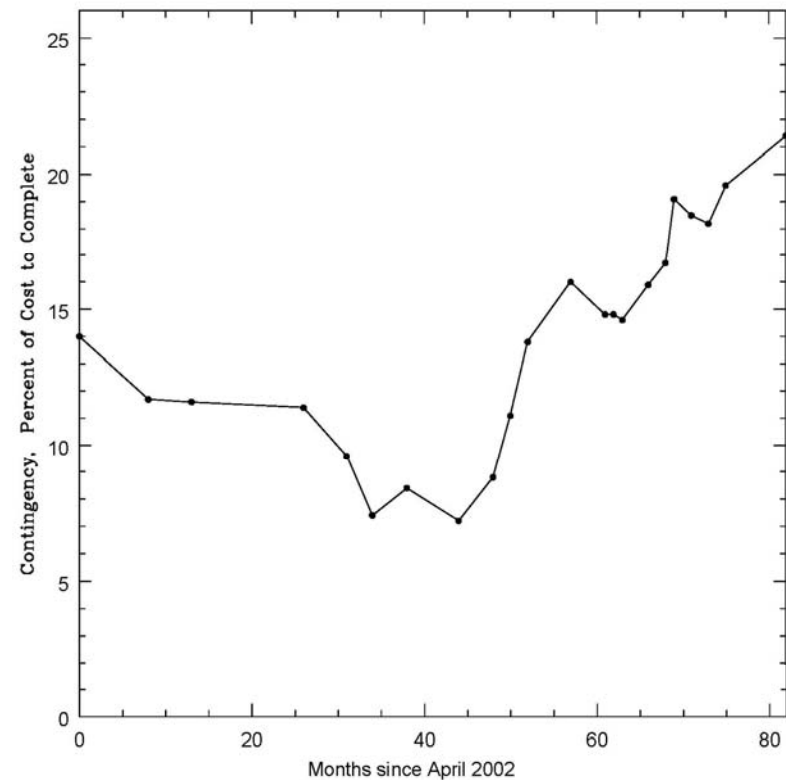


Budget: Funding

- Funding = \$93.8M (FY06)
 - New NSF funds \$58.7M
 - Provided over 11 years
 - NRAO contributed effort \$16.3M
 - Canadian partner \$17.0M
 - Contribute correlator
 - Mexican partner \$1.8M
 - Funds received

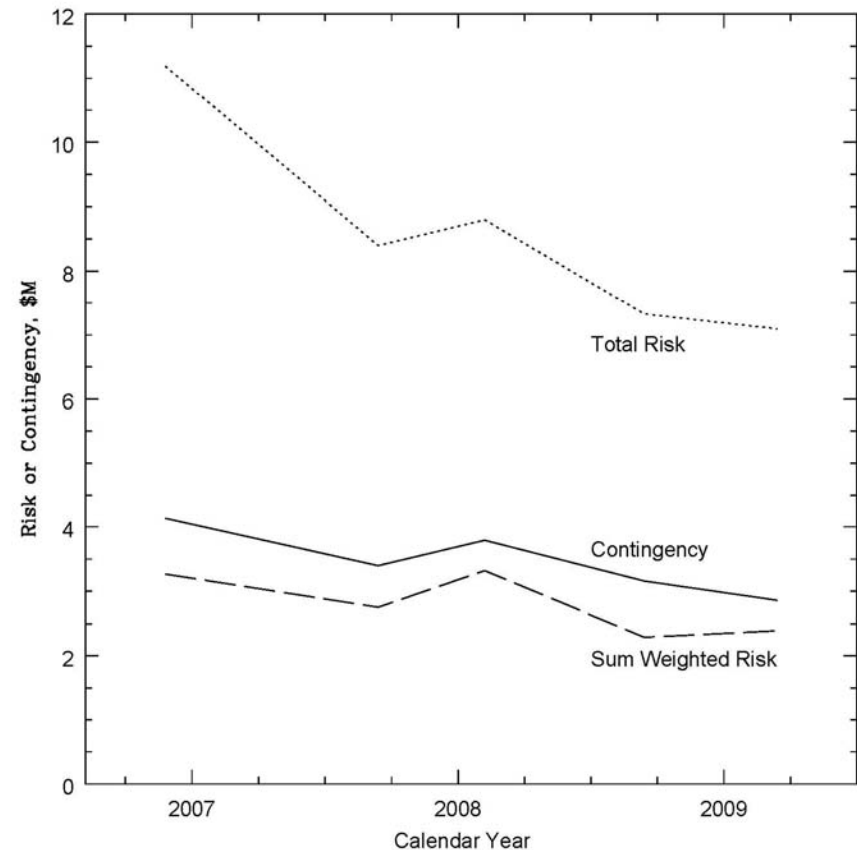
Budget: Contingency

- Financial health of project is good
- All WBS elements of the project are operating within their budget allocations
- Project contingency, as percent of cost to complete:
 - Has improved over last 3 years
 - Remains at historically high levels
 - 21.4% (\$2.86M)
 - Does not include work on the correlator, which is supported by Canadian funds
- No plans to exercise potential hardware descope options

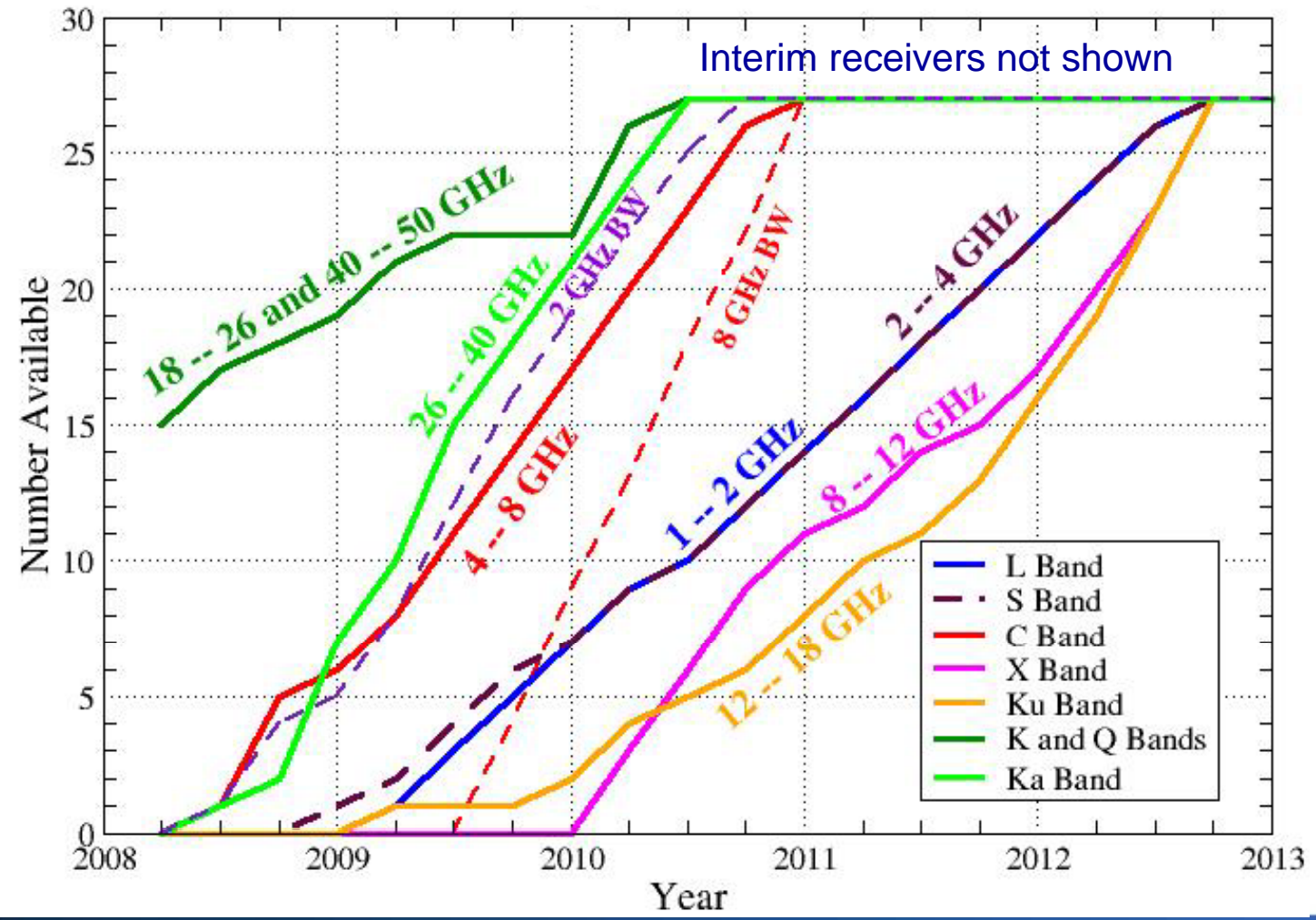


Risk Management

- Risk management plan developed in Dec 2006
 - Financial impact and probability of occurrence for each risk are estimated
- Risks actively managed
 - Since the plan was established, the total number of risks has decreased from 79 to 46
 - Total risk has decreased from \$11.2M to \$7.1M
 - Sum weighted risk has decreased from \$3.3M to \$2.4M
 - Contingency has always exceeded weighted risk, but is less than the total risk.
- Current challenge is effective allocation of contingency to mitigate remaining risks



Schedule: Growth of New Capability



Schedule

- Project is on schedule
- At current rate, antenna conversions will be complete by Q3 CY2010
- Correlator on schedule for completion in Q1 CY2010
- Remaining major milestones paced by correlator delivery:
 - Installation of final WIDAR boards begins Q2 CY2009
 - Anticipate first science with WIDAR in Q1 CY2010
- Receiver installation to be complete in Q4 CY2012
- Development of M&C software and basic user tools on track to support commissioning and early science observation

Summary

- Good progress has been made over past 18 months
- Project is going well
- Budget: Financial health of the project is good
- Technical issues largely resolved
- Project is on schedule:
 - Antenna retrofits will be complete in Q3 CY2010
 - Receiver installation complete in Q4 CY2012
 - Correlator scheduled for completion in Q1 CY2010
 - Software development on track to support commissioning and early science

Backup

Budget: NSF Funding Profile

Year	Initial (\$K)	Current (\$K)
2001	1,106	3,000
2002	6,900	5,000
2003	5,322	5,322
2004	5,434	9,340
2005	5,548	5,340
2006	5,665	5,440
2007	5,835	5,835
2008	6,010	6,010
2009	6,190	6,190
2010	6,376	6,376
2011	4,597	1,130
Total	58,983	58,983

Budget Distribution by WBS

WBS Element	Description	% of Total Cost
601	Project Management	4.7
602	Systems Integration	6.6
603	Civil Construction	2.7
604	Antennas	4.9
605	Front End Systems	20.7
606	LO Systems	6.0
607	Fiber Optic Systems	10.8
608	IF Systems	6.0
609	Correlator	17.5
610	Monitor & Control	12.6
611	Data Mgt. & Computing	7.5
612	Education & Outreach	0.0

Risks by WBS Element

WBS	Risk Number	Total Impact (\$K)	Wt. Impact (\$K)
Project Management	3	2,557	856
Systems Integration	2	100	10
Civil Construction	5	205	45
Antennas	3	355	83
Front End	10	1,202	549
Local Oscillator	1	300	90
Fiber Optics	3	115	45
Intermediate Freq.	0	0	0
Correlator Interface	2	190	128
Monitor & Control	7	570	194
Data Management	10	1,500	390

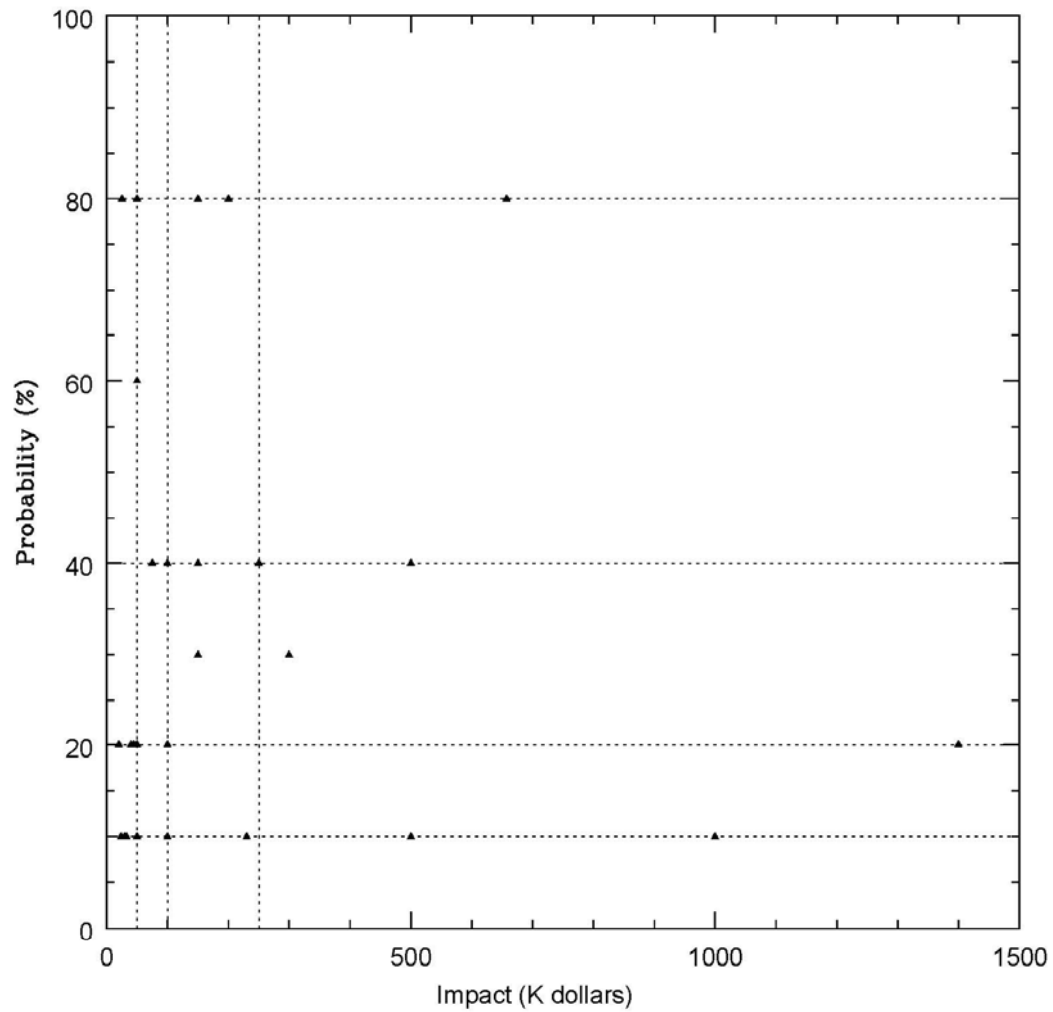
Risks Affecting Budget or Schedule

- Deployment of high speed samplers
 - Contingency plans well developed
 - Production should commence this summer
- Selection of X-band OMT
 - Design of planar-style OMT pursued as risk mitigation measure to larger, conventional, waveguide-style OMT
 - Selection will be made in next few months
- Virtual Correlator Interface (VCI)
 - Software that configures correlator for observations
 - Main focus of DRAO software development effort
- TelCal
 - M&C software that intercepts visibility data and performs calculations needed to derive Telescope Calibration quantities
 - Issue caused by staff departure. Replacement hire underway.

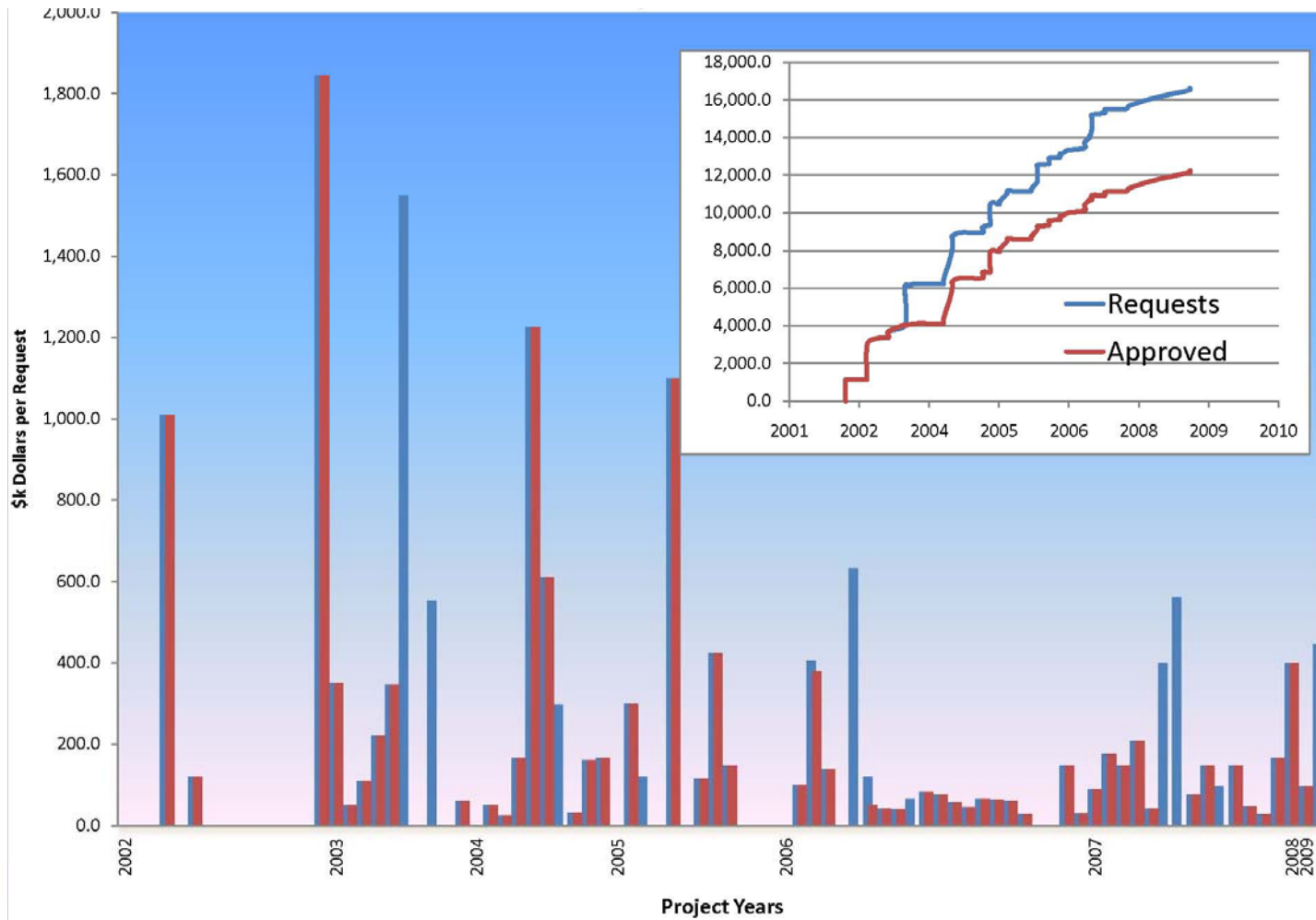
Examples of Retired Risks

- Retired risks (\$ = impact, % = probability)
 - Correlator spare boards (\$200K, 40%)
 - Design path for 3-bit sampler (\$510K, 40%)
 - Outsourcing of machined components for front ends (\$600K, 80%)
 - Marching army costs in front end group (\$464K, 40%)

Risk Summary



Change Board History



Descope Options

- Given good financial health of the project, there are no plans to exercise descope options
- Descope options amount to receiver bands
 - Ka, S, and Ku-bands were under consideration for descope long ago, but we are now proceeding with their full production
 - Still possible to descope X-band: \$1.0M
 - Could also eliminate solar observing mode: \$0.2M
- Impact
 - Advertised scientific productivity of EVLA requires all hardware and software deliverables to be met.
 - Recovering from descopes would take many years.